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The Breeding Habits of the Least Darter, *Microperca punctulata* Putnam

By Joseph J. Petravicz

SEAL (1892), Reeves (1907), Reighard (1913), Jaffa (1917), Adams and Hankinson (1928) and Hankinson (1931) have published accounts of the spawning habits of certain species of darters, but no one, so far as I can learn, has described the breeding habits of the smallest of the darters, namely, *Microperca punctulata* Putnam, or the Least Darter.

The breeding habits of the Least Darters are somewhat different from those of the species described by the authors mentioned above. The Least Darters do not, as the Tesselated Darters (*Boleosoma nigrum olmstedi*) observed by Seal, lay their eggs by repeatedly passing over a small area, nor do the males guard the eggs during incubation. The eggs are not laid in batches as in the Log Perch (*Percina caprodes*) as described by Reighard, nor devoured immediately by supernumerary males. Unlike the Rainbow Darters studied by Reeves, the Least Darter males do not maintain definite breeding territories or "holdings."

Methods

Least Darters were obtained from the Bell Branch of River Rouge in Detroit near the intersection of Six Mile and Farmington roads. Specimens were abundant, even during the winter months, in patches of *Elodea* growing in about 12 inches of slowly moving water. For study under controlled conditions specimens were gathered monthly and placed in a balanced 12-gallon glass aquarium containing a sandy bottom, few stones, and abundant vegetation; the aquarium was kept near a window and maintained at a temperature of 18° to 20° C. The fish generally refused artificial foods and became emaciated, unless fed such live food as small crustaceans.

Sexual Dimorphism

The sexual dimorphism of the Least Darters is shown particularly by differences in coloration and in the structure of the fins of male and female. The anal and pelvic fins of the male have a reddish orange tint and the anterior dorsal fin is decorated by a median row of prominent red spots, one between each spine. The pelvic and anal fins of the female are almost transparent and the dorsal fins are marked by alternate indistinct transverse bands of brown and gray.

The ventral or pelvic fins of the male, which serve as clasping organs, are slightly concave with the concavity directed medially, and have a noticeable skin-like appendage along the outer proximal margin (Fig. 1), which is usually folded down over the lower surface of the fin. The pelvic fins of the female are smaller than those of the male; they are not concave, nor have they an appendage along the proximal margin (Fig. 2).

Appearance and Behavior

The coloration of the Least Darters is relatively dull during July and August, but increases in intensity as spring or the spawning season approaches. Maximum brilliancy of color is achieved during the months of April and May.

Specimens collected during the months of December, January, and February after a few days in the warmer temperature of the aquarium occasionally assumed the clasping position, and the males made feeble and

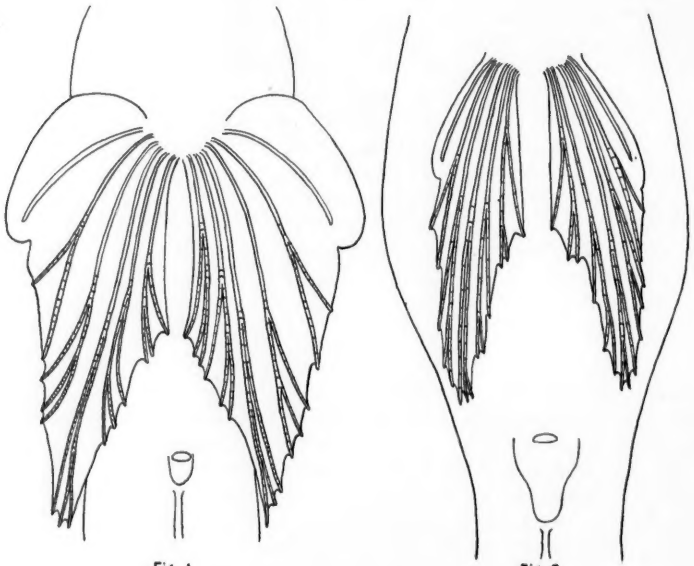

Fig. 1. Pelvic fins of male, extended, ventral view.
Fig. 2. Pelvic fins of female, extended, ventral view.

unsuccessful attempts to induce the female to spawn (Fig. 3). Least Darters gathered during the latter part of March presented a highly colorful appearance which indicated that spawning had begun or was not far distant; these fish spawned in the aquarium within ten days after capture. In the natural habitat spawning was first observed on April 26, when the temperature of the water was about 12° C.; specimens gathered on that day and placed in the aquarium spawned the following morning. The breeding habits of the Least Darters were quite similar in stream and aquarium.

On May 5 the spawning habits of the Least Darters were again studied in the natural habitat; at the same time the territory was examined for temperature change and pH content. At a depth of 6 inches the temperature varied from 13.5° C. in the morning to 15.5° C. in the afternoon; in the afternoon the pH content was between 7.9 and 8.0. It is noteworthy that on this occasion hauls of fish made in *Elodea* growing in 2 to 3 feet of

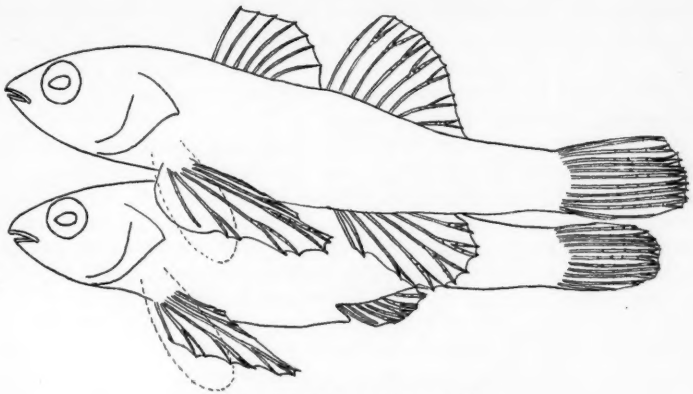

Fig. 3. Clasping position, × 3⅔.
Dotted lines represent the extended pectoral fins.

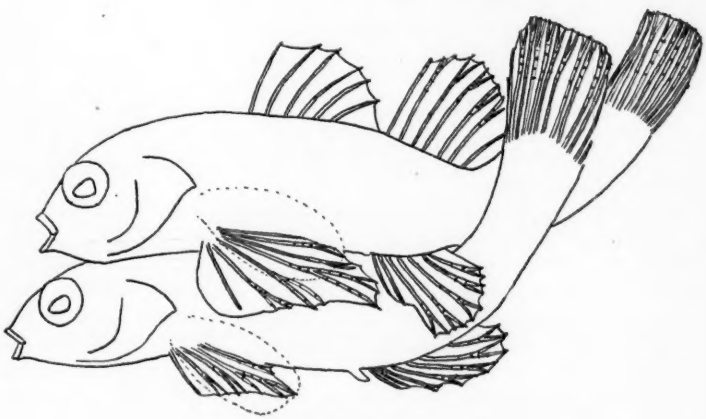

Fig. 4. The spawning act, × 4.
Dotted lines represent the extended pectoral fins.

water in mid-stream generally yielded an excessive number of females; one such haul contained several hundred females for each male. Hauls made near shore yielded both males and females, but the former were more abundant. This distribution of sexes leads to the conclusion that during the breeding season females remain in deeper water until they are prepared to spawn; they then enter the inshore spawning territory occupied by males.

The appearance of the Least Darters during the spawning season is noteworthy. In all the specimens, including females and very young males, the olivaceous background and longitudinal black blotches are of a dark hue,

and a patch of peacock-green decorates the cheeks. The abdominal region of the larger females is greatly distended with eggs and marked by a prominent genital papilla posterior to the anal opening. With the exception of the differences noted above, the females and very young males undergo very little change during the spawning season.

The coloration of the mature males during the nuptial season is very striking. A general intensification of color has taken place. In addition, the red spots on the anterior dorsal fin are intensely brilliant and beautifully set on a contrasting background of dark gray or black. A deep reddish orange tint brightly colors the anal and ventral fins while a mixture of gold and peacock-green adorns the cheeks. Transverse bands of alternating pale gray and dark brown decorate the caudal and posterior dorsal fins.

Spawning

When a female is prepared to spawn she seems to make a definite attempt to attract the attention of males. I have frequently observed a lone female leave a patch of vegetation and come to rest in a conspicuous territory where she can be easily discovered by males. The males, of course, swim to the spot and vie for the clasping position (Fig. 3). The female, however, disregards the contesting males, returns to the vegetation, and pursued by males, continues to dart about hither and thither apparently seeking a suitable place for the laying of an egg. Whenever the movements of the female become sufficiently slow or when she comes to rest on some object the males contend for the spawning position, and it is generally the largest and most colorful individual who jostles away the others and assumes a parallel position on her dorsal surface.

Once in the clasping position the male tries to induce the female to spawn by beginning an irregular side-to-side tremor of the head and anterior region of the body. This is repeated at frequent intervals. When she is prepared to lay the egg she responds to this stimulus with a similar vibration. While the two are vibrating rapidly from side to side she so curves the body that the genital papilla is placed on the selected spot, where a single adhesive egg is laid; at the same time the male similarly curves his body so that sperm is ejected near the egg (Fig. 4). Then the vibration, which lasts only a few seconds, ceases. The gaping mouth and tense attitude of the body indicate that the spawning act is an unusual strain on both participants.

As soon as the egg is laid the female usually swims from beneath the male and comes to rest for a few minutes. The male follows her closely and also comes to rest either near her or upon her dorsal surface in preparation for the deposition of the next egg. In a few minutes with one or more males in hot pursuit she sets out in search of another suitable locality and when that is found the spawning act is repeated.

During the vibratory period and spawning act the relative position of male and female is firmly maintained by means of the fins. The pelvic fin of the male is an effective clasping organ for it is slightly concave in shape and possesses a flap-like appendage on the outer proximal margin (Fig. 1). The appendage and shape of the fin enable the male to obtain a saddle-like

grasp on the lateral and dorsal surfaces of the female. The position of the remaining fins is as follows: the anal fin of the male is fully extended and pressed against the lateral wall of the female; the posterior dorsal fin of the female is likewise extended and pressed against the lateral wall of the male opposite his anal fin; the anterior dorsal fin of the female is folded but both dorsal fins of the male are fully spread; the caudal fins are frequently crossed at the base.

The anal fin of the female which is just posterior to the genital papilla may aid her in orienting her position while laying an egg on a small object such as a leaflet of milfoil. As the fish wriggles through a patch of leaflets the anal fin seems, at times, to catch as an anchor thus guiding the female in placing the genital pore and depositing the egg on the selected spot.

In the aquarium a catch of fish will spawn for about a week after capture; they then return to their usual habits of resting on branches of vegetation and gathering food. During a day of spawning, which begins at dawn and continues until midday or late afternoon, a female lays about 30 eggs.

Behavior of Rival Males

Previous to or even during the spawning act one or more rival males may try to buck away the male holding the clasping position. The attempt is often successful and the dislodged male, if not too small, with colors flashing and fins outspread dashes at the intruders. None of the fishes seems to suffer any injury from these momentary skirmishes of color. Often the male returns; but frequently distracted by another female about to spawn he follows the new acquaintance.

The males of this group of darters do not seem to possess the individual "holdings" described by Cora Reeves for the Rainbow Darters. The males in the spawning position resent intruders but they do not seem to restrict their spawning activities to any one or two square feet of territory. Only once in the acquarium, and never in the natural habitat, have I observed a male confining his spawning activity to a branch of vegetation from which he chased other males.

Supernumerary males do not immediately devour eggs fertilized by rival males. Although eggs placed conspicuously on the sides of the aquarium were left unharmed by Least Darters they were destroyed by minnows. During the spawning period I have seen wandering males snap at objects on leaves of plants, but I was unable to ascertain whether the objects were eggs or bits of ordinary food.

It is not rare to observe a male chase another male of less brilliant coloring and assume a clasping position on his dorsal surface. The fish maintain the position for a few moments and then swim apart. An examination of the gonads of a male treated as a female revealed normal testes. The error is probably due to a failure to recognize the sex of the less brilliant male.

Place of Spawning

Eggs are laid on submerged vegetation, on small objects in the water, in sand, and, as frequently happens in the aquarium, on the glass sides. The greatest percentage of eggs is laid on the bottom or sides of the stems or leaves of aquatic plants.

The laying of an egg on the bottom of a small leaflet or on the vertical wall of an aquarium presents a problem to the spawning fish, because they lack a swim bladder, yet must maintain their respective positions in mid-water during the vibratory period. The problem is skilfully solved in hummingbird-fashion by rapid vibrations of pectoral and caudal fins of both fishes, and the posterior dorsal fin of the male.

When the egg is to be laid in the sand the female dives into it and stirs it up until she is partly buried; the male assumes the spawning position and the egg is laid and fertilized in the usual manner. This habit was observed only in aquaria with a bottom of fine sand and few plants.

It is noteworthy that when a female begins to lay eggs in one type of material, for instance the stems of plants, she rarely changes to another type, such as a sandy bottom.

Incubation Period

After deposition, some eggs, 0.7 mm. in diameter, were collected from the aquarium and placed in a small jar of water kept at a temperature of 18° to 20° C. About 10 percent of the eggs were unfertilized. Within 50 hours the heart began to beat, at a rate that increased to approximately 150 beats per minute just prior to hatching. After 80 hours the blood was found flowing. The incubation period was 145 to 150 hours and the length of the newly hatched fish was 3 mm. from tip of snout to extremity of caudal fin.

Bibliography

Adams, Charles C., and Hankinson, Thomas L.

1928 The ecology and economics of Oneida Lake fish. *Roosevelt Wild Life Annals,* 1 (3-4)=*Bull. N. Y. St. Coll. Forestry,* 1 (4a): 235–548, figs. 175–244, pls. 1–4, map 16.

Hankinson, Thomas L.

1932 Observations on the breeding behavior and habitats of fishes in southern Michigan. *Pap. Mich. Acad. Sci., Arts and Letters,* 15, 1931: 411–425, pls. 33–34.

Jaffa, Bertram B.

1917 Notes on the breeding and incubation periods of the Iowa Darter, *Etheostoma iowae,* Jordan and Meek. Copeia, 47: 71–72.

Jordan, D. S., and Copeland, H. E.

1876 Johnny darters. *Am. Nat.,* 10: 335–341, figs. 22–24.

Putnam, F. W.

1872 The etheostomoids. *Am. Nat.,* 6: 109–115, figs. 3–8.

Reeves, Cora D.

1907 The breeding habits of the Rainbow Darter (Etheostoma coeruleum Storer), a study in sexual selection. *Biol. Bull.,* 14: 35–59, figs. 1–3.

Reighard, Jacob

1910 Methods of studying the habits of fishes, with an account of the breeding habits of the Horned Dace. *Bull. U. S. Bur. Fish.,* 28 (2), 1908: 1111–1136, figs. 1–5, pls. 114–120.

1913 The breeding habits of the Log-perch (Percina caprodes). *Rep. Mich. Acad. Sci.,* 15, 1913: 104–105.

Seal, W. P.

1892 Observations on the aquaria of the U. S. Fish Commission at Central Station, Washington, D. C. *Bull. U. S. Fish. Comm.,* 10, 1890: 1–12, figs. 1–2, pls. 1–4.

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A Third Record of the Albulid Fish *Dixonina nemoptera* Fowler, with Notes on an Albulid from the Eocene of Maryland[1]

By George S. Myers

The primitive teleostean fishes of the family Albulidae have long interested anatomists because of the presence of a rudimentary conus arteriosus with two rows of valves, reminiscent of the ganoid heart, as well as on account of their remarkable eel-like "leptocephalid" larvae. One living genus and species, *Albula vulpes*, of worldwide tropical range, is commonly recognized, if we exclude from the family the very different deep-water

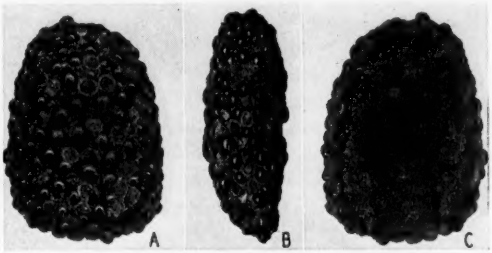

Fig. 1. Crushing dentition of albulid fish from the Aquia Eocene, Liverpool Point, Maryland. Natural size: *A*, front view; *B*, side view; *C*, back view.

Pterothrissus. The nominal *Albula virgata* Jordan and Jordan[2] from Hawaii, said to differ from *A. vulpes* in the possession of longitudinal dark stripes, does not appear to be recognizable on that character. It was based on a formalin specimen, and all formalin specimens of *Albula* I have examined, from any region, show similar stripes of varying intensity. One such is a large specimen from Sausalito, San Francisco Bay, in the Stanford Museum. It is likely, however, that a careful statistical analysis of the anatomical variations of *Albula vulpes* will show the presence of more than one recognizable form, but any such study must be based on larger material than most museums possess. The length of the mouth and other proportions of the head are slightly but clearly different in some samples I have examined.

In view of the commonness of *Albula* and the length of time it has been known, it is rather remarkable that the very distinctive second living species of the family was not discovered until 1911. Fowler[3] described *Dixonina nemoptera* from a single 15 inch specimen collected many years ago by William Gabb in Santo Domingo. Nothing more was heard of the species until Metzelaar[4] recorded one small specimen of 260 mm. from Puerto Cabello, Curaçao. He did not recognize the genus *Dixonina*, and consequently reported the fish as *Albula nemoptera*.

[1] Published with the permission of the Secretary of the Smithsonian Institution.
[2] Mem. Carnegie Mus., 10, 1922: 6, pl. 1, fig. 1.
[3] Proc. Acad. Nat. Sci. Philadelphia, 62, 1910 (1911): 651, 1 fig.
[4] Rapp. Vissch. Indust. Zeeprod. Kol. Curaçao (Boeke), Tweedie Ged., 1919: 9.

In view of the striking superficial similarity of the two genera, it might be suspected that specimens of the rarer form had sometimes been mistaken for *Albula*. With this in mind I recently went over the albulids in the National Museum. The result was the discovery of a fine 15-inch adult of *Dixonina nemoptera*, the third known specimen. This fish (U. S. N. M. 75547) was received in exchange many years ago from the Museum of Comparative Zoology as an *Albula*. Neither the name of the collector nor the date of collection has been preserved and even the date of receipt is in doubt. The locality given is Acapulco, Mexico. If this datum can be trusted, *Dixonina nemoptera* is not confined to the Caribbean but is to be looked for on the Pacific Coast of tropical America as well. The fact that the Albulidae are certainly an ancient family makes it seem likely that the genus *Dixonina* is as old as the last isthmian connection of the Atlantic and Pacific. Viewed with this in mind, the presence of *D. nemoptera* in the Pacific would not be especially remarkable.

In the *Megalops*-like character of produced last dorsal and anal rays, as well as in the large mouth, which extends nearly or quite to the vertical of the middle of the eye, *Dixonina nemoptera* differs widely from *Albula*. Further, the snout projects much farther beyond the mouth and the head is much larger and more evenly conical than in *Albula*. Despite these distinctive features, *Dixonina* is exceedingly similar to *Albula* in general appearance and there is little doubt that other specimens besides the one in hand have been overlooked among examples of their commoner relative.

It is possible that the range of *Dixonina* is much larger than suspected and that it will turn up on the West African Coast or in the Indo-Pacific region. Certainly careful examination should be made of *Albula* specimens from the West Indies and the Pacific Coast. This should be easier than formerly since *Albula* has become so well known and popular as the hard-fighting "bonefish" of tropical marine anglers.

Several fossil albulids are known. *Albula oweni* (Owen) is known from dental fragments and imperfect skulls from the lower and middle Eocene of England and Belgium.[5] White[6] recorded *Albula eppsi* White and Frost from the Eocene of England (Blackheath Beds at Abbey Wood and London Clay Basement Bed at Harefield), based on portions of the crushing dentition, part of an operculum and numerous otoliths. More recently, White[7] recorded an undetermined *Albula* from the Eocene of Northwestern Nigeria based on one imperfect crushing dentition. Cockerell[8] based *Albula antiqua* on a scale from the Cretaceous of Florida.

It is therefore of interest to record a nearly perfect oval patch of crushing teeth of an albulid from the Aquia formation of the Eocene at Liverpool Point, Maryland. The specimen was collected by Mrs. Doris H. Blake in 1935 and turned over to me for examination through the courtesy of Dr. S. F. Blake and Mr. C. W. Gilmore. It is catalogued in the Division of Vertebrate Paleontology of the United States National Museum as No. 13855.

[5] Woodward, Cat. Foss. Fish. Brit. Mus., 4, 1901: 60, pl. 4.
[6] Vert. Faunas of the English Eocene, 1, 1931: 83, figs., 137–140, pl. 1, fig. 8.
[7] Geol. Surv. Nigeria, Bull. 14, 1934: 47, p. 10, fig. 19.
[8] COPEIA, 1933 (4): 226.

The fact that the crushing dentition of *Dixonina* is scarcely or not distinguishable from that of *Albula* shows that we cannot determine the generic position of isolated fossil dental plates, at least in harmony with our modern system. I do not, therefore, attempt to give a name to the Maryland fossil.
U. S. NATIONAL MUSEUM, WASHINGTON, D. C.

The Spawning Activities of Fresh Water Smelt, with Special Reference to the Sex Ratio [1]

By EARL E. HOOVER

RELATIVELY little has been published and apparently few observations have been made on the spawning activities of the fresh water smelt, *Osmerus mordax* (Mitchill). In his extensive paper on *The Smelts*, Kendall (1927) dismissed the subject of spawning habits with only a few pertinent observations. Greene (1930: 114) wrote: "No person, it is believed, has ever actually observed the spawning of the Lake Champlain smelts." Creaser (1926) and Langlois (1935) have made some significant observations on the spawning of smelt in Michigan.

The writer has had the opportunity of making observations on smelt throughout their seasonal run in Black Brook, a tributary of Winnisquam Lake, near Laconia, New Hampshire. The stream was visited many times during the season and intensive observations were made over a 14 hour period during the high run of smelt, from the evening of May 6 to the morning of May 7. Previous to May 1 the brook was open to smelt fishing and was so disturbed that no significant observations could be made.

The first run of smelt occurs in Black Brook during the first 2 weeks of April. The average date for the initial run (ascertained by averaging records for the past 4 years) is April 11. The runs gradually increase in number of fish until a climax is reached during the first week of May and then rapidly diminish in frequency and in number of fish. A few smelt have been seen in the brook as late as May 16. It is believed that the beginning, climax, extent and intensity of the run are somewhat dependent upon the average temperature of the brook. Smelt begin to run as soon as the ice goes out of the lake. They have never been observed to frequent the brook when the temperature exceeded 60° F., and they have generally behaved in accord with Greene's findings (1930: 116): "The smelt have been observed to run in temperatures from 2 to 15 degrees C. (35.6 to 59 degrees F.), but more usually from 3 to 12 degrees C. (37.4 to 53.6 degrees F.)." It is generally assumed by fishermen that warm days and cool nights create optimum conditions for good smelt runs.

Study was confined to the 14 hour period of continuous observation unless noted otherwise, and also to the so-called smaller race of smelt (Kendall, 1927: 292, and Greene, 1930: 106). The average size of Winnisquam smelt

[1] Published under a grant from the American Wildlife Institute, for the publication of biological contributions fundamental to fish management.

(ascertained by measuring 70 individuals) was 104 mm. for females and 99.5 mm. for males. During the entire run only 5 smelt (all females) were observed that greatly exceeded these figures; their average size was 173 mm.

Observation of Smelt During Day

Many smelt from the previous night's run remained in the brook throughout the day. They were not evenly distributed, but sought the deeper and darker holes, 3 feet or more in depth. At 5:00 P.M., 263 of these fish, taken in a dip-net, were hastily examined to determine their sex. Of this number all except 2 were males, and only 3 of the 261 examined were spent. The ovaries of the 2 females were not well developed. The determination of the sex of smelt during the spawning season is a simple matter, because the males

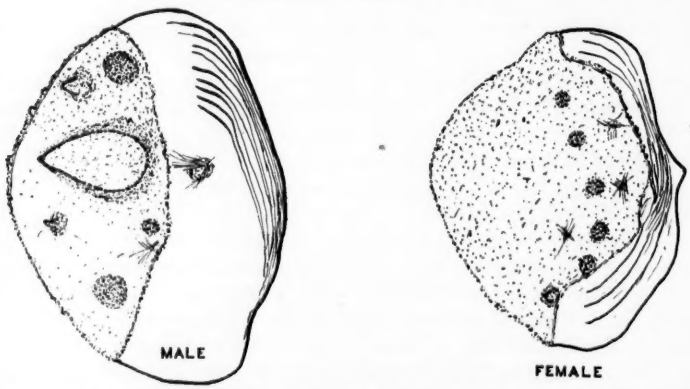

Fig. 1. Camera lucida drawing of scales taken from a male smelt, showing nuptial tubercles, and from a female smelt.

are then covered with nuptial tubercles (Fig. 1) and are rough to the touch, while the females are smoother; if this method at any time is doubtful, a slight pressure may be exerted on the sides of the fish to cause them to extrude milt or eggs. No difference in coloration was noted between male and female smelt. The tubercles are not visible when the fish are in the water.

All studies made of the smelt that remained in the brook confirmed the same singular conclusion, that only the males remain in the stream during the day, or, that the males then predominate more than 100 to 1. Kendall (1927: 299) wrote: "It frequently has been stated and generally supposed that after spawning smelts invariably return to the lake on the night of their ascent. The writer's observations on the marine smelt in small coastwise brooks revealed that, when undisturbed during the night, large numbers, if not all, remained in the brook the next day. . . . Those remaining after the spawning season, so far as examined, always proved to be males." Observations made at Black Brook confirm Kendall's statement that males tend to remain in the brook, but indicate that only a very small percentage of the night's run (estimated at less than 1%) remains in the brook during the daytime.

The males that remain in the stream during the day are rather inactive, but they do feed (also in accord with Kendall's observations). The digestive tracts of 20 fish examined were all found to contain food of the following general types, listed according to relative abundance: (1) Crustacea (Cladocera most numerous); (2) other zooplankton (*Arcella*, sp., predominating); (3) phytoplankton; (4) smelt eggs (7 fish contained from 1 to 3 smelt eggs). Males that were actively spawning at night were also found to contain food, but no spawning females were found to have recently fed.

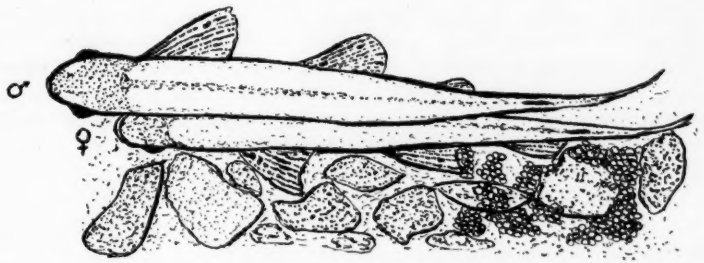

Fig. 2. Dorsal view of male and female smelt in spawning position, showing type of gravel usually chosen for spawning and a mass of eggs (all life size).

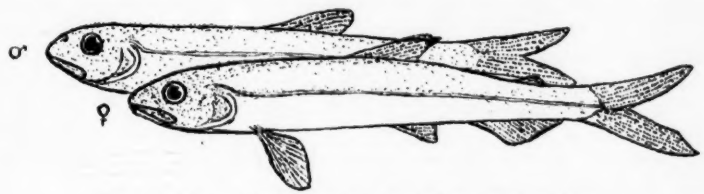

Fig. 3. Male and female smelt in typical spawning position.

Spawning Habits

At approximately 6 P.M. the males that had remained in the pools during the day became active, and began to move slowly upstream to distribute themselves over the spawning beds. It is believed that some of the males, after selecting their positions over spawning beds, remained in the same area of the stream during the entire night. Barriers in the brook, such as logs, offered obstructions which tended to induce spawning, provided the downstream bottom was suitable (Fig. 2). As they took their places over the spawning beds the males oriented themselves in relation to the current with heads pointing upstream. They began to move in a seething, milling manner, first to one side, then to the other; moving upstream against the current, only to float back to their original positions, but always keeping their heads upstream. Two liters of water were collected from under the active fish, centrifuged, stained with nuclear dyes, and examined microscopically, but no sperms were found. Males deposit milt only when associating with females.

A station was now selected, and all observations were confined to a single spawning bed. The number of fish in the stream was constantly increasing and females were now making their appearance (Table 1; 7:40 P.M.). The sexual importance of the tubercles on the scales and the undulating sidewise motion of the males now became evident. At almost every movement to the side the body of one fish came in contact with that of another. When a male contacted another male, the 2 fish quickly separated and resumed their undulating motion; but when a tubercle-covered male came in contact with a non-tuberculated female, the male immediately assumed a position slightly anterior and slightly dorsal to the female (Fig. 3), and violently drove her into the bottom or shoreward. Spawning began when the males predominated 4 to 1, and increased in intensity as the sex ratio became more nearly equal. At the height of the run (Table 1 and Fig. 4; 10:40 to 11:25 P.M.) many pairs of fish constantly broke water, causing a continuous rippling sound. At the height of the run (Table 1 and Fig. 4; 10:40 to 11:45 P.M.) many bank of the stream by the momentum of their spawning movements. When the females were low in proportion to the males, 3 and 4 males were seen attending a female, but when the sex ratio was nearly equal, a single male to a female was the rule.

It is a common though erroneous belief that the smelt deposit all of their eggs at one time. The number of eggs in a female (104 mm. average length) was found to range from 1700 to 7000, but at no time was a female observed to deposit more than 50 eggs regardless of how violently she was thrown against the bottom. All eggs were not deposited directly on the bottom. In accord with the observations by Langlois, some eggs were collected in a bottle suspended in the current 10 inches above the stream bed.

The spawning activities of the smelt were observed by the light of a kerosene lantern. It was found that the fish react positively to a steady light, but avoid any light that moves or fluctuates in intensity. Creaser (1925: 413) reported only negative responses to light.

On the night of May 7 and morning of May 8 smelt spawned on pieces of burlap placed in the stream for that purpose. The burlap with the eggs was then placed in a box constructed with sides of burlap which permitted a complete circulation of water but prevented other smelt from depositing eggs on the original pieces of burlap. The box containing the eggs, deposited at a known time, was placed in the brook on May 8 and observed from time to time to ascertain the hatching period. The container was placed in the stream on May 8, and on May 18, when the contents of the box were studied microscopically, fry were observed emerging from eggs. The temperature of the brook during this period ranged from 50° to 62° F., with an average of 58.9° F., ascertained by averaging the 3 temperature readings recorded each day.

Sex Ratio

The sex ratio of males to females was subject to many changes during the night, fluctuating from 261:2 to 15:30, then back to 103:0 (Table 1). The accompanying graph (Fig. 4) illustrates the fluctuation in the percentage of females to the total number of fish, as counted during an overnight

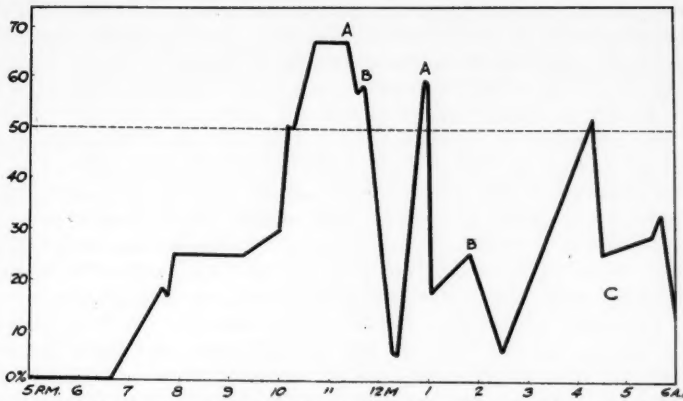

Fig. 4. Variation in percentage of females to the total number of smelt examined, during a 12 hour period at the same point in Black Brook.

TABLE I. DATA ON SEX RATIO OF SMELT ON ONE SPAWNING BED IN BLACK BROOK, AT DIFFERENT TIMES DURING ONE NIGHT

Time	Number of Fish Sexed			Percentage of Females	
	Males	Females	Total	To Total	To Males
5:00 P. M.	261	2	263	.01	.01
6:38 P. M.	25	0	25	.00	.00
7:35 P. M.	31	0	31	.00	.00
7:40 P. M.	37	8	45	.18	.22
7:48 P. M.	20	4	24	.16	.20
7:55 P. M.	12	4	16	.25	.33
8:30 P. M.	18	6	24	.25	.33
9:10 P. M.	18	6	24	.25	.33
10.05 P. M.	14	6	20	.30	.43
10:10 P. M.	14	14	28	.50	1.00
10:15 P. M.	34	34	68	.50	1.00
10:40 P. M.	10	19	29	.66	1.90
11:25 P. M.	15	30	45	.66	2.00
11.35 P. M.	19	25	44	.57	1.32
11:45 P. M.	15	21	36	.58	1.40
11:50 P. M.	26	22	48	.46	.85
11:55 P. M.	24	16	40	.40	.66
12:15 A. M.	45	7	52	.13	.16
12:20 A. M.	47	3	50	.06	.06
12:55 A. M.	20	29	49	.59	1.45
1:05 A. M.	45	10	55	.18	.22
1:50 A. M.	15	5	20	.25	.33
2:30 A. M.	30	2	32	.06	.07
4:15 A. M.	33	36	69	.52	1.09
4:35 A. M.	26	9	35	.26	.35
5:30 A. M.	15	6	21	.29	.40
5:45 A. M.	12	6	18	.33	.50
6:00 A. M.	9	2	11	.18	.22
6:10 A. M.	8	1	9	.11	.12
6:30 A. M.	103	0	103	.00	.00

observation at one station on the stream. It is interesting to note that the females exceeded 50% of the total at 3 distinct times during the night. The number of females rapidly increased and rapidly decreased. It is well known by smelt fishermen that 2 runs occur each night; the first between 10 and 11 P.M. and the second between 12 M. and 1:30 A.M. During these periods, as may be noticed by reference to the graph, there was a high percentage of females (designated as points A). The females rapidly decreased in proportionate numbers after the peak of the run was reached, with the exception that for a short period there was a slight increase (points B on graph). It is believed that this increase was due to the females that had ascended the stream above the station of observation and were again counted when they reappeared at the station during their descent to the lake. Many females and some males were observed to return to the lake after the climax of each run. It is not known if the same fish returned to the spawning beds again during the same night, or even during the same season. It is probable, however, that the fish ascended the spawning stream several times during the season, because many females collected on their descent to the lake were found to contain eggs.

It is evident from these observations that the sex ratio fluctuates during the night. Probably one series of runs differs from others, and the runs of one brook from another. Due to this variation it is impossible to estimate accurately the relative abundance of males or females without making observations for a prolonged period of time at a selected spot in the stream. Therefore results obtained without consideration of actual time of observation, such as Kendall's (1927: 300), do not provide an accurate indication of the sex ratio, but would throw some interesting light on the seasonal fluctuations if the records were made at the same time of night, when the run is well under way. Greene (1930: 115) sensed this difficulty, for he wrote: "The proportion of males to females is often seen to change greatly during the course of a single evening." He further cautioned (p. 117) against hasty deductions: "The difficulties of gaining an accurate idea of the proportion of males to females should be recognized."

The observations of Kendall and Greene on the occurrence and relative abundance of males and females during the season are of interest. Greene (p. 116) wrote: "The beginning of the run is commonly composed of a very high percentage of male fish which are usually small. The females and larger males appeared at the height of the run and the last of the run is again composed of smaller fish . . . on May 3 (end) almost all were males." If these observations are correct, much can be gained by careful study during one night when the run is high, because the entire season's runs in regard to the sex ratio are recapitulated in a single night.

It is evident from the foregoing observations that a careful study of sex ratio during a season in any smelt brook could be used to regulate smelt fishing, so that the reproductive capacity of the species could be maintained.

Dr. C. F. Jackson, University of New Hampshire, and Dr. W. Gardner Lynn, The Johns Hopkins University, are thanked for reading the manuscript.

LITERATURE CITED

CREASER, CHARLES W.
1926 The establishment of the Atlantic smelt in the upper waters of the Great Lakes. *Pap. Mich. Acad. Sci., Arts and Letters,* 5, 1925: 405–423, fig. 25, pls. 24–27.

GREENE, C. WILLARD
1930 The smelts of Lake Champlain. In: A Biological Survey of the Champlain Watershed. *Suppl. to 19th Ann. Rep. N. Y. Cons. Dept.,* 1929: 105–129, 4 figs.

KENDALL, WILLIAM CONVERSE
1927 The smelts. *Bull. U. S. Bur. Fish.,* 42, 1926: 217–375, figs. 1–25.

LANGLOIS, T. H.
1935 Notes on the spawning habits of the Atlantic smelt. COPEIA, 1935 (3): 141–142.

NEW HAMPSHIRE FISH AND GAME DEPARTMENT, CONCORD, NEW HAMPSHIRE.

Specificity of the Pituitary Gonadotropic Factor as Demonstrated in Amphibia[1]

By CHARLES W. CREASER and AUBREY GORBMAN

THE fact that the pituitary hormones derived from different taxonomic groups may, in certain cases, be interchanged in the experimental induction of ovulation has caused many workers to postulate that the vertebrate pituitary gonadokinetic factor or factors are constant and non-specific for the whole sub-phylum.[2] On the other hand a significant amount of data is being accumulated which appears quite incompatible with the concept of non-specificity of the gonadotropic hormone.[3] The number of cases in which it has been demonstrated that heteroplastic implants and injections of gland extracts of extra-specific origin are ineffective has occasioned considerable caution and doubt in the minds of some workers in regard to the universal validity of the non-specificity concept, at least as applied to the gonadotropic hormones. The instances of refractoriness to extra-specific treatment are significant not only in the frequency of their occurrence, but also in the fact that their explanation has been, on the whole, quite unsatisfactory and not based on experimental evidence.

It is the purpose of the present study to demonstrate, in a limited field, the occurrence of such negative results in ovulation induction and to analyze experimentally the nature of this apparent specificity. It is probable that if this problem is satisfactorily cleared up for the amphibia, or even for a single member of this group, the data may be of value in elucidating the specificity problem in more complex groups.

[1] This study has been aided by the government agency N.Y.A. and the alumni research fund of the biology department.
[2] P. E. Smith in E. Allen, 1932, *Sex and Internal Secretions,* The Williams and Wilkins Co., Baltimore. Pp. 754–755.
[3] P. E. Smith, 1935, General physiology of the anterior hypophysis, J.A.M.A., 104: 548.

Rana pipiens, a species known from previous experience to be quite refractory to extra-specific treatment, was selected as test animal. Negative results in ovulation induction in this frog were obtained in treatment with whole pituitary implants from the fishes *Stizostedion vitreum, Perca flavescens,* and *Cristovomer namaycush,* and in the injection of extracts of: beef anterior-lobe, sheep pituitaries, pregnant mare's serum, and human pregnancy urine. The extracts were Parke, Davis and Company preparations. Positive ovulation induction was obtained only by homoplastic implantation and implants of glands from *Rana sphenocephala,* a southern form considered by many as synonymous with *R. pipiens,* and from certain other amphibia of the genus *Rana.* Wills, Riley, and Stubbs[1] cite the instance of ovulation induction in a single specimen of *R. pipiens* with implants from the fish *Lepidosteus.*

In order to show that it was a difference in the actual substance with which the frog was treated, and not experimental circumstances, which caused the different results in ovulation induction, the following series of experiments was undertaken. Groups of at least five frogs constituted a unit test group (except in the case of pregnant mare's serum, in which three frogs were used). Implants were made in the dorsal lymph space, and injections in the dorsal or lateral lymph spaces.

Size of dose as a factor, as has been suggested by some authors, was checked by varying the dose from small to very large proportions. The specimens receiving the different doses served as reciprocating controls and were further checked by groups receiving .7% saline solution. Variation of the dose had no effect on the negative results.

Having shown after extended treatment that negative results were not a function of the dosage size, it was possible to show that all such environmental factors as temperature, presence of the male, character of the surroundings, etc., and also such individual factors as concern the physiological condition of the frog were likewise not the inhibiting items. For this purpose several of the specimens of each group which had given negative results were picked at random and given homoplastic implants. This treatment was always attended by ovulation, showing that at all times during the treatment which had given negative results the animal had been perfectly capable of ovulation. The unimplanted negative frogs served as controls for this latter check. Furthermore, this method of check justifies the relatively small number of specimens in the test groups, if this needs justification, because it indicates that at least the data obtained from each specimen is valid.

It has thus far been shown that in one case, when homeo-implants are introduced into a frog capable of ovulation, it ovulates, and in another case when a certain preparation is introduced into a similar frog no ovulation occurs. Since it has been shown that experimental conditions are probably not the responsible factors the only variable between the two cases is the nature of the substance introduced into the test animal. Effort toward defining the nature of the apparent specificity was therefore directed toward the factors contained in the introduced material itself.

[1] A. Wills, G. M. Riley, E. M. Stubbs, Proc. Soc. Exp. Biol. and Med., 30: 784, 1933.

It was considered advisable to check whether freshness was a factor in the case of fish pituitary implants. The glands for the previous implants had been collected from fish obtained as soon as possible after removal from the nets. To determine whether any possible hormone destruction or denaturation had occurred as a result of hydrolytic or putrefactive processes a number of frogs were implanted with varying numbers of glands taken directly from fish killed in the laboratory. The use of fresh glands had no effect on the negative results. The data of Stein[5] who implanted *Triturus* with chicken pituitaries, the same stock of glands lasting over a week, with positive results, indicates that the hormone destruction is probably not very rapid under more favorable conditions.

Another possible factor in the inhibition of ovulation induction lies in the fact that concomitantly introduced substances, such as the preservative and solvent materials in the extracts, might lower the physiological tone of the specimen, or might have direct organic or other effects rendering the animal incapable of response to the action of the hormone. It had been observed in previous work that animals physiologically "low" due to parasitization or red-leg infection would not respond even to homoplastic implants. On the basis that *R. pipiens* might be more susceptible to the action of tricresol of other substances in the sheep pituitary extract than those which ovulate when treated with the same product, simultaneous injections of extract and homoplastic implants were made into three previously untreated frogs. Two of these last ovulated after one such treatment; the other specimen ovulated after a second treatment. On the assumption that the cumulative action of the injurious substances might have a more pronounced inhibitory action on the test, three more frogs were "conditioned" by previous injections of sheep pituitary extract before starting the combined extract and homoplastic implant treatment. One frog died after the fifth daily injection of .8 cc of the extract. Its ovaries were in the same stage of development as those of an untreated control killed at the same time. Another specimen ovulated after five daily .4 cc injections of sheep extract followed by two combined treatments in which it received .4 cc of extract and three homeo-implants each time. The other specimen was prepared with six 1.0 cc injections followed by one combined treatment of three homeo-implants and 1.0 cc of extract. It ovulated after the first combined treatment. This data indicates quite clearly that although the accompanying materials often exercise some toxic action on the specimen they are not, in this case, the factors which account for an inhibition of the action of the hormones from the sheep gland. In view of the facts already pointed out the latter evidence also serves as a rather striking indication of the difference in effectiveness of the two types of preparations.

In conclusion, may it be stated that in the light of the experimental data presented here it appears that there is an interspecific variation in the gonadotropic hormones despite the currently accepted concept of absolute hormone uniformity. The important bearing of any demonstrated specificity on hormone physiology is evident.

[5] Stein, K. F., Proc. Soc. Exp. Biol. and Med., 32, 1935: 157.

Experiments have been formulated and are now in the process of being carried out in which an attempt is being made to understand the mechanism of the production of negative ovulation-induction results in the frog (e.g. antagonistic serum substance as antibodies or "antihormones," or temperature, etc.). It is believed that if the mechanism of the non-action or inactivation of gonadotropic substances is better understood, it will offer further information as to the nature of these hormones.

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The Nomenclature of Western Coral King Snakes, *Lampropeltis zonata* Versus *L. multicincta*

By CHARLES E. BURT

IN a recent publication Linsdale (1932: 378) has used the name *Lampropeltis zonata* (Lockington) for this species. His account may be quoted as follows:

> The reasons for the use of the name *zonata* rather than that of *multicincta*, the name adopted by Blanchard (1921, 222) and Stejneger and Barbour (1923, 100) are as follows: Blainville (1835, 293) gave the name *Coluber zonatus* to a snake which he described so incompletely that, after the type had been lost, Stejneger (1902, 153) considered the case and recommended that the name be dropped altogether as unidentifiable with any known snake. Lockington (1876, 52) described the present species, giving it the name *Bellophis zonatus* . . .
>
> Since Blainville's name cannot be assigned to any known species it need not be considered in this case, for Lockington assigned the species he described to a separate genus. Thus he, probably unintentionally, insured his species against being considered a synonym of *Coluber zonatus*. It seems plain that *Bellophis zonatus* Lockington (1876) is the earliest name to be applied correctly to this species. The name given it by Yarrow was not applied until 1882.

Thus it is clear that Linsdale did not base his use of the name *zonata* on Blainville's description, accepting in this interpretation the action and comment of Stejneger (1902), Blanchard (1921), and Stejneger and Barbour (1923). It follows without further comment that if the identity of Blainville's *Coluber zonatus* with Lockington's *Bellophis zonatus* were proven, the snake under discussion would be called *Lampropeltis zonata* (Blainville). In order to discuss an unusual nomenclatorial situation, we may momentarily disregard this issue (as recent workers have done). Let us consider what the status of Lockington's species would be if it is not identical with Blainville's. The status of Lockington's name rests on (1) whether

it was really a *new* specific designation applied to the present species before the description of *multicincta,* or (2) whether it was merely an *old* specific name listed under a new generic head, and hence not really a new specific designation at all.

Under the date of September 21, 1932, I received the following communication from Dr. Stejneger:

> In reply to your inquiry of September 16 about my present opinion on the nomenclatorial question of *Lampropeltis multicincta* versus *L. zonata* in view of Linsdale's recent resurrection of the latter, I can only say that his argumentation has not changed my previous opinion. I need only quote this sentence by Lockington (1876, 53): "It is very probably the same species (as Blainville's), and for this reason I have preserved HIS *specific name* of *zonatus,* but the entire last abdominal scuta, want of carination of the dorsal scales, and smaller number of abdominal scutillae, appear to me to necessitate the formation of a new genus." Therefore, Lockington instituted a new genus (*Bellophis*), but he preserved Blainville's old name *zonatus.*

In view of this explanation, Linsdale's use of the name *zonata* would appear to be unwarranted by the facts in the case. Barring the identity of Lockington's and Blainville's species, the next available name is *multicincta,* which was described by Yarrow (1882: 440).

After reading the above comments, Mr. Klauber wrote as follows under the date of February 23, 1933:

> I think that the last word in the *multicincta-zonata* controversy has not been said. Even supposing that Lockington was trying to describe a genus rather than a species, the fact remains that he did describe both. Therefore, the question is whether, under the rules, a description of a new genus and a new species is invalidated as to the species part, if the describer thinks that he is describing an old species under a new generic name, whereas he is really describing a new species under a generic name that is actually not new.

Next, the problem was referred to Dr. Carl L. Hubbs of the Committee on Nomenclature of the American Society of Ichthyologists and Herpetologists, who has submitted the following discussion in Communication No. 9 under the date of March 7, 1933: *On the availability of a given species name as used under a different genus, when the name as first employed was probably based on a different species, but is not now regarded as definitely identifiable:*

> The only basis in the action of the International Commission on Zoological Nomenclature which seems to bear out Linsdale's contention is a part of Opinion 97, reading as follows: "Even if it be admitted that the binomials represent combinations of generic plus specific names, they are essentially *nomina nuda* (as of the date in question) since authors who do not possess esoteric information in regard to them are unable definitely to interpret them without reference to later literature. If published with more definite data at later dates, these names have their status in regard to availability as to their date of such republication."
>
> On this basis one might argue that since *Coluber zonatus* is regarded as a virtual *nomen nudum,* the name *zonatus* should take its status in regard to availability as of its date of republication, i.e., by Lockington. But the present case is distinct in that the *species* called *zonatus* by Blainville and by Lockington are regarded as probably different. The rules themselves seem to definitely cover this situation.
>
> Article 31 states that "a specific name which undoubtedly rests upon an error of identification cannot be retained for the misdetermined species even if the species in question are afterwards placed in different genera." It seems quite immaterial that the specific name *zonatus* was placed by Lockington himself in a new genus. It is universal good practice not to validate misidentified specific names used as types of new genera.

The use of the word "undoubtedly" in this Article is unfortunate, because the only practicable criterion must be that of regarding the species as identical or as distinct.

There is nothing in the Rules to support Linsdale's contention that Blainville's name *zonatus* "need not be considered." A species name obviously acquires "availability" when proposed in such a way as to make it the "valid" name on first usage (Article 25). There are two stipulations: (a) That this name was published and accompanied by an indication, or a definition, or a description; and (b) that the author has applied the principles of binary nomenclature.

Clearly *Coluber zonatus* is an "available" name, on objective grounds. Whether it is "valid" is a matter of systematic, not nomenclatorial decision. The availability of a name and not its validity is what brings the Rules to bear upon it. (Thus any available name regarded as invalid because interpreted as a synonym, nevertheless precludes any later use of the same name.)

Article 31 does not demand that the name on original usage be valid; clearly the only demand is that it be available. So long as *Bellophis zonatus* (Blainville) Lockington is regarded as distinct from *Coluber zonatus* Blainville, the name *zonatus* Lockington cannot be regarded as valid. If, however, the names should be regarded as having been certainly or probably based on the same species, then that species should be known, on premises submitted, either as *Lampropeltis zonata* (Blainville) or *L. zonata* (Lockington), accordingly as Blainville's description is regarded as adequate for identification or not.

On January 14, 1936, while Dr. Frank N. Blanchard was visiting me in Winfield, he generously consented to help with the translation of Blainville's original description of *zonata* (1835: 293–294) and to venture an opinion as to its identity. Since then our joint translation from the French has been checked through the kindness of Miss Emily Ericsson, Professor of French and Spanish at Southwestern College. The translation follows:

Coluber (Zacholus) zonatus

Body cylindrical, back rather flat, somewhat ridged, tapering quickly behind and but little in front; head small, tetragonal; snout blunt and thick; tail short, small and very pointed. Nostrils lateral, large, and funnel-shaped, between the two nasal scutes. Eyes large and lateral. Mouth very big; anus very far back.

Head plates: 4 frontals, 1 very small loreal, very small oculars (1 preocular and two postoculars). Scales rather large, rhomboidal, somewhat overlapping, forming oblique rows on the sides, subconvex and perfectly smooth.

General color of a faded reddish-yellow, entirely ringed with deep black, with 2 half-rings of the same color on the head.

Total length 415 millimeters, of which 55 comprise the tail, which makes it a little more than a seventh of the total length.

This pretty species is remarkable for its color pattern, which is often found among the more or less venomous aquatic serpents. It is, however, a truly harmless colubrine form.

Dr. Blanchard, who has revised the kingsnakes (1921), sees in this description nothing that could not be applied to Lockington's *zonata* and to Yarrow's *multicincta*. Blainville's ocular count is rather significant. His "subcaréné" refers to a ridging of the back and not to the scales, which were perfectly smooth ("parfaitment lisses"). The name "*zonatus*" itself suggests the banding so characteristic of the coral king snakes. Blainville's specimen was evidently a preserved one in which the original red bands had faded remarkably. The alternate black bands are characteristic, and a black half-ring is on top of the head, while another crosses the occiput. The tail percentage of snakes is of diagnostic significance. In this case the

tail is 13.25 per cent of the total length; and on the basis of 38 measurements Blanchard found (1921) the range of variation for his *multicincta* to be from 13.1 to 16.1 with figures near the lower extreme occurring several times.

There are several banded types of western snakes that might have been in Blainville's collection and each of these must be considered here. The true coral snake of the west (*Micruroides euryxanthus*) is very venomous, but the original *zonatus* was described as being a "truly harmless snake." Also *Micruroides* has no loreal, very small eyes, a short tail (Van Denburgh's measurements, 1922, give a percentage of total length of only 9.35), and a range outside of modern California and away from the sea coast of the west.

The Arizona ringed snake, *Lampropeltis pyrrhomelaena,* is excluded on the basis of tail measurement (Blanchard's data on 28 specimens, 1921, indicate a range of variation of 15.3 to 18.1); moreover, the form does not occur along the western sea coast.

The western milk snake, *Lampropeltis getulus boylii,* does not have red in the banding and the darker rings would not be described as deep black in preserved specimens.

In the ground snakes (*Sonora*) the eye is always rather small, the total length is less than 415 mm., the head is not tetragonal, the rings are incomplete, and the snout is rather wedge-shaped in *occipitalis,* the most western species.

All other western snakes differ more widely from the diagnosis given by Blainville than those above, especially in coloration, so it appears that the following synonymy is appropriate for the western coral king snake.

Lampropeltis zonata (Blainville)

Coluber (*Zacholus*) *zonatus* Blainville, 1835: 293 (type locality, California).
Bellophis zonatus Lockington, 1876: 52.
Ophibolus getulus multicinctus Yarrow, 1882: 440 (type locality, Fresno, California).
Lampropeltis zonata Van Denburgh, 1897: 167. Linsdale (after Lockington), 1932: 278.
Lampropeltis pyrrhomelaena multicincta Stejneger, 1902: 153. *L. multicincta* Blanchard, 1921: 222. Stejneger and Barbour, 1933: 108.

In conclusion, it seems appropriate to offer a deduction concerning Blainville's taxonomic sense and descriptions. He worked at a very favorable period for species hunters (1835), yet it seems significant indeed that all of the reptile species that he described with *Coluber zonatus* are regarded as valid today. In modern nomenclature these are *Callisaurus draconoides draconoides, Phrynosoma coronatum coronatum, Pituophis catenifer catenifer, P. vertebralis, Thamnophis sirtalis infernalis, Lampropeltis californiae californiae,* and *Tantilla planiceps.*

Literature Cited

Blainville, H. D. de
1835 Description de quelques Espéces de Reptiles de la Californie. *Ann. Mus. Paris,* (3) 4: 233–296, pls. 24–26.

Blanchard, Frank N.
1921 A revision of the king snakes, genus *Lampropeltis. Bull. U. S. Nat. Mus.,* 114: 1–260.

LINSDALE, JEAN M.
1932 Amphibians and reptiles from Lower California. *Univ. Calif. Publ. in Zool.*, 38: 345–386.
LOCKINGTON, W. N.
1876 Description of a new genus and species of colubrine snake. *Proc. Calif. Acad. Sci.*, (1) 7: 52–53.
STEJNEGER, LEONHARD
1902 The reptiles of the Huachuca Mountains, Arizona. *Proc. U. S. Nat. Mus.*, 25: 149–158.
STEJNEGER, LEONHARD, and THOMAS BARBOUR
1923 A Check List of North American Amphibians and Reptiles, ed. 2: 1–171.
1933 *Ibid.*, ed. 3: 1–185.
VAN DENBURGH, JOHN
1897 The reptiles of the Pacific Coast and Great Basin. *Occas. Pap. Calif. Acad. Sci.*, 5: 1–236.
1922 The reptiles of western North America. *Ibid.*, 10: 1–1028.
YARROW, H. C.
1882 Description of new species of reptiles and amphibians in the U. S. National Museum. *Proc. U. S. Nat. Mus.*, 5: 438–443.

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Observations on the Brown Snake *Storeria dekayi* (Holbrook), with Especial Reference to the Habits and Birth of Young[1]

By H. J. CLAUSEN

ALTHOUGH the small brown snake, *Storeria dekayi* (Holbrook), is a fairly common species throughout the eastern United States, there seem to be very few records on the seasonal habits, size of the broods, period of gestation, and the birth of young. Ditmars (1907) probably gives the most extended report on the habits, distribution and size of the brood. His notes on the birth of young are based on four specimens. Shields (1929) reports the birth of young from one adult female and Force (1930) also reports the birth of young from one specimen which she collected. So far as I am aware, no reports as to the period of gestation, or the habits of the female during this period, have been reported for this species.

It was with the idea of making a study of the social behavior of this species (Noble and Clausen, 1933, and Clausen, 1934), that a most comprehensive study of this snake was made under laboratory conditions and in the field.

[1] This investigation has been aided by a grant from the Josiah Macy, Jr., Foundation.

Storeria dekayi is found extensively in the vicinity of Flushing, Long Island, and collections were made from time to time over a period of two years. Four hibernating dens were also examined and more than 200 snakes removed from them. Over 600 snakes were brought back to the laboratory and more than 300 additional ones were marked, according to the method of Blanchard and Finster (1933), and released so as to secure more data on the movements and social habits of this snake. It has been shown (Noble and Clausen, 1936) that the female snakes are consistently found isolated during the period of gestation under normal conditions in the field as well as under laboratory conditions.

The above studies on aggregation and isolation have also been useful in securing more complete data on gestation as presented in this report. It can be noted from the table that copulation in *S. dekayi* occurs during the last week of March or the early part of April. It is probably true that environmental conditions such as temperature have a definite influence on the breeding period. Nevertheless, the data, as presented in the table, were secured over a period of two years and should therefore be considered as having covered to some extent the range of variation caused by temperature fluctuations. No records of breeding were obtained in the field. The eight specimens on which the above records were based were obtained in the following way: four of the snakes were removed from a hibernating den on December 7 and brought into the laboratory. They were placed in hibernation again under conditions which would approximate those found in the field for the remainder of the winter and were removed from the artificial den as soon as any snakes were found leaving their natural hibernating dens in the field. Snakes 5, 6, 7 and 8 were collected and brought to the laboratory on March 28. They were kept at temperatures approximating those found outside and the following day snake number 7 copulated with a male. The remaining three snakes of this group were breeding several days later. The males used in the above group were collected and kept under conditions similar to those of the females.

After copulation the females were marked and placed in large glass-sided cages with screened covers. Other male and female snakes were placed in the same cage. The floor of the cage was covered with a layer of gravel and several layers of moss which were kept moist at all times. Earthworms were placed in the cage daily and a small dish of water was kept in the cage at all times.

Two months later the gestating females were found isolated from the non-gestating females and the male snakes as well as from one another. At no time were the gestating snakes found actively crawling around in the cage as were the males and non-gestating females.

At the time the above females were found in an isolated condition three more gestating females (9, 10, and 11) were found in the field also under pieces of paper and in an isolated condition. They were brought back to the laboratory and placed in individual cages under the same conditions as found in the field. Observations on birth of the young and habits of these three were then continued as with the other groups. Three other gravid

DeKay's were discovered in the field under small pieces of cardboard and isolated from one another. These three snakes (12, 13 and 14) were left in the field and observations were made every week up to the parturition dates. These three snakes were always found under the same cover and probably remained under cover most of the time since no gravid females were ever found crawling around in the grass, while immature females and males were caught frequently at this time. The cardboard under which the gravid females were found was always in a moist locality. The ground under the paper was moist at all times and earthworms could usually be found under the paper.

The parturition dates of the above fourteen gravid females were recorded (Table I). The period of gestation covered a considerable range. The first individual gave birth to young on July 14, while the last occurred on August 1. However, since the copulation records were not complete for the entire group of fourteen snakes, the length of the gestation period was necessarily considered from the first eight snakes only. It has already been stated that the breeding season is not an exact factor, therefore the time at which parturition occurred would be expected to vary considerably. Nevertheless, if the above factor is taken into consideration, it can be noted that the

TABLE I

Records of gestating female *S. dekayi* and the birth of young

Cases	Date of Copulation	Date of Parturition	Number of Young	Av. Length of Young in mm.	Remarks
1	April 2	July 18	14	88	1 still born
2	April 5	July 22	16	99	2 still born
3	April 3	July 22	9	103	
4	April 8	July 25	17	103	2 still born
5	April 9	July 30	20	108	4 still born
6	April 5	July 26	18	96	1 still born
7	March 29	July 14	14	96	
8	April 8	July 21	11	98	1 still born
9	No record	July 29	13	102	Collected June 10
10	No record	Aug. 1	17	103	Collected July 8
11	No record	July 20	12	99	Collected June 11
12	No record	July 24	14	101	Weekly field observations from April 10 to parturition
13	No record	July 28	17	99	Field observations from April 21
14	No record	July 25	13	100	Field observations from June 2

period of gestation, from copulation to parturition, varied in itself considerably. From the records it can be seen that the gestation period varied from 105 to 113 days. The mean average was approximately 109.5 days.

From these data on the length of the gestation period it may thus be concluded that the length of the period is more or less exact for this species of snake. The actual date of parturition is no doubt largely due to differences in the breeding time. This latter variation is doubtless due to temperature, but the variation in length of the gestation period itself in *Storeria*

is probably a normal variation for the species and not a temperature influence as suggested by Ruthven (1912 and 1915) for *Thamnophis* where the variation was considerably greater. Normal variations of 8 days are not at all uncommon in warm-blooded animals where temperature obviously has no direct influence.

At the time of parturition the female appeared to be restless until four to six hours prior to deposition of the young. Occasional contortions of the body were noticed at this time. However, during deposition the snake remained comparatively quiet until the last embryo was deposited. The female then became restless again and attempted to move about the cage but the efforts were quite feeble and the animal appeared to be too weak to crawl about very much.

The young, at the time of birth, were folded in such a manner that the mid-region of the body was usually the first part to emerge. The thin enveloping membrane of the embryo was usually broken first in the head region and then gradually slipped off of the remaining portion of the body to the region of attachment just anterior to the anal plate. When the animal began to crawl around in the cage this latter portion was also released. The deposition of all embryos within a female required, on the average, six minutes for the fourteen cases under observation. The time involved was proportional to the total number of young deposited per female.

The number of young from each female varied from 9 to 20 with a mean of 14 for the group. It was also of interest to note that the number of young per individual was not in any way correlated with the average size of the young at birth. Female No. 5 gave birth to the largest number (20) and in this case, the average length of the young (108 mm.) happened to be the optimum for the entire group. This female was smaller than snakes 1, 2 or 8; hence there is also no correlation between the size of the female and the number of young deposited.

The average length of the young at birth varied from 88 to 108 mm. with a mean of 93.2 mm. All young snakes were sexed at the time the above measurements were made. It was found that in most cases the young females were larger than the males. The sex ratio for the entire group was 110 females and 95 males. For individual females the ratio was also nearly 1:1.

The young snakes, after escaping from the enveloping membrane, were quite active and began moving around the cage at once. They were fed earth worms and *Drosophila* (wingless) at all times and seemed to feed on both types of food and remain healthy. On several occasions small earthworms were placed in the cages and the young snakes were observed trailing an earthworm-scented trail over the moss by means of their protruding tongues. Young snakes, ten minutes after they were deposited by the female snake, were seen eating earthworms.

The young snakes, at the time of birth, were very dark or nearly black in appearance and with a grayish yellow band around the neck. They shed their skins one to two hours after birth and during the first three weeks, shed several times more. After each successive shedding the color pattern seemed to change from deep black to a rich brown and finally to the grayish

brown color more or less typical of the adult color. The grayish yellow neck band darkened with each successive shedding until it eventually blended in with the rest of the color pattern of the body.

Summary

1. Observations were made and data recorded on the habits and birth of young *Storeria dekayi* (Holbrook).
2. Breeding activity occurred during the last week of March or early part of April.
3. Gestating females were always found inactive and isolated under various types of debris while males or immature females were active and usually in aggregates.
4. The gestation period varied from 105 to 113 days with a mean average of 109.5.
5. The number of young per female varied from 9 to 20 with an average of 14 plus, for the group.
6. The average size of the young varied from 88 to 108 mm., with a mean average of 93.2 mm.
7. The coloration of the young became more and more like that typical of the adult with each successive shedding.

Literature

Blanchard, F. N., and Finster, Ethel B.
1933 A method of marking living snakes for future recognition, with a discussion of some problems and results. *Ecology*, 14: 334–347.

Clausen, H. J.
1934 The effect of aggregation on oxygen consumption in snakes. *Anat. Rec.*, 60 (Suppl.): 49.

Ditmars, R. L.
1907 The Reptile Book. Doubleday Page & Co., New York.

Force, Edith R.
1930 The amphibians and reptiles of Tulsa County, Oklahoma, and vicinity. Copeia, No. 2: 25–39.

Noble, G. K., and Clausen, H. J.
1933 The aggregation responses of *Storeria* and other snakes. *Bull. Ecol. Soc. Amer.*, 14 (4).
1936 The aggregation behavior of *Storeria dekayi* and other snakes, with especial reference to the sense organs involved. *Ecological Monographs* (in press).

Ruthven, A. G.
1912 On the breeding habits of Butler's garter snake. *Biol. Bull.*, 24: 18–20.
1915 The gestation period in *Thamnophis butleri* (Cope). Copeia, No. 15.

Shields, F. B.
1929 Notes on the young of *Storeria dekayi*. Copeia, No. 171: 52–54.

American Museum of Natural History, New York City.

The Horned Toads of the *coronatum* Group

By L. M. Klauber

During the past year the San Diego Society of Natural History series of reptiles has been augmented by material from northern Lower California collected by Messrs. Chas. F. Harbison and Curtis W. Brown. Included were a number of horned toads from between San Quintin and Punta Prieta (Lat. 29° N.), an area previously unrepresented in collections. These specimens close the last extensive gap in the territorial distribution of available specimens of the *conoratum* group between Kennett, California, on the north, and Cape San Lucas on the south. It therefore appears opportune to examine this series to determine the validity of the several names which have been proposed for these coastal horned toads, and particularly the relationship between *coronatum* and *blainvillii*, the forms found at the southern tip of Lower California, and in upper California, respectively.

The following forms have been described:

1835 *Agama* (*Phrynosoma*) *coronata* Blainville, Nouv. Ann. Mus. Hist. Nat. Paris, 4: 284. Type locality "Californie" (generally assumed to be the Cape Region of Lower California). Type specimen in the Natural History Museum at Paris; collected by P. E. Botta.

1839 *Phrynosoma blainvillii* Gray, Zool. Beechey's Voyage: 96. Type locality "California" (generally assumed to be the vicinity of San Diego, California). Type specimen in the British Museum; presented to the museum by H. de Blainville.

1893 *Phrynosoma cerroense* Stejneger, N. Amer. Fauna, No. 7: 187 (foot note). Type locality Cerros (= Cedros) Island. Type specimen USNM 11977; collected by L. Belding.

1894 *Phrynosoma frontalis* Van Denburgh, Proc. Cal. Acad. Sci., Ser. 2, 4: 296. Type locality, Bear Valley, San Benito County, California. Type specimen, Stanford 93; collected by W. W. Price.

1921 *Phrynosoma schmidti* Barbour, Proc. N. Eng. Zool. Club, 7: 113. Type locality Cerros (= Cedros) Island. Type specimen MCZ 15142; collected by W. W. Brown.

1922 *Phrynosoma nelsoni* Schmidt, Bull. Am. Mus. Nat. Hist., 46: 666. Type locality, San Quintin, Lower California. Type specimen, AMNH 37585; collected by E. W. Nelson and A. E. Goldman.

1922 *Phrynosoma jamesi* Schmidt, Bull. Am. Mus. Nat. Hist., 46: 668. Type locality, San Bartolome, Lower California. Type specimen, USNM 64450; collected by H. Townsend.

1932 *Phrynosoma ochoterenai* Terron, Anales del Inst. Biol., 3: 109. Type locality, Tecate, Lower California. Type specimen from the collection of the National Museum of Natural History, Mexico, D. F.;[1] collected by J. M. Gallegos.

[1] The type is said to be no longer in the museum, according to del Campo, Anales del Inst. Biol., 5, 1934: 331.

Thus, we have to consider eight suggested forms, six mainland, and two island. Rearranged in territorial order from north to south with the approximate latitudes of the type localities, they are as follows:

Mainland

frontale	36° 30′ N.	*nelsoni*	30° 30′ N.
blainvillii	33° N. ?	*jamesi*	27° 40′ N.
ochoterenai	32° 40′ N.	*coronatum*	23° N. ?

Island

cerroense	28° 15′ N.	*schmidti*	28° 15′ N.

With the exception of *ochoterenai* the type localities are separated by about 3 degrees of latitude, or about 120 miles when allowance is made for the northwest-southeast trend of the coast. Altogether, these forms cover about 1400 miles of the Pacific Coast of the Californias.

Because of the inadequate descriptions of the two forms first described (*coronatum* and *blainvillii*), and their uncertain type localities, they were for a long time confused. Stejneger discussed the matter in 1893 (N.A. Fauna, 7: 187), and pointed out that *coronatum* was the proper name for the Cape form, while *blainvillii* was applicable to the horned toads of upper California. He considered them separate species.

This view was reiterated by Van Denburgh in 1894 (Proc. Cal. Acad. Sci., Ser. 2, 4: 296), at which time he demonstrated that the San Diegan horned toad differed from that of central California; and, as the name *blainvillii* was presumed to be applicable to the former, he named the latter *Phrynosoma frontalis*. In 1897 (Occas. Pap. Cal. Acad. Sci., 5: 95) he suggested that if the two forms of upper California were found to intergrade, the northern form must be reduced to subspecific status as *Phrynosoma blainvillii frontale*. This view was confirmed by Bryant in 1911 (Univ. of Cal. Pubs. in Zool., 9: 38).

In 1922, Schmidt, with new material available and noting the wide territorial separation between *blainvillii* and *coronatum*, interposed between them the forms *nelsoni* and *jamesi* as full species.

More recently Linsdale (Univ. of Cal. Pubs. in Zool., 38, 1932: 367) concluded from additional specimens resulting from the Alexander acquisitions in Lower California, that the gap was closed between *blainvillii* and *coronatum*, all forms intergrading. He therefore visualized the group as

Phrynosoma coronatum coronatum — *Phrynosoma coronatum frontale*
Phrynosoma coronatum jamesi — *Phrynosoma coronatum cerroense*
Phrynosoma coronatum blainvillii

Linsdale omitted *nelsoni*, finding insufficient differences between *jamesi* and *blainvillii* to warrant the interposition of another race. Del Campo (Anales del Inst. de Biol., 5, 1934: 330) observed the affinity of *ochoterenai* Terron to this group and, following Linsdale, applied to it the name *P. c. ochoterenai*.

The Cedros Island form *cerroense* has usually been considered a valid species, although given subspecific status by Linsdale. *P. schmidti* was deemed a synonym of *cerroense* by Van Denburgh in 1922 (Occas. Pap. Cal. Acad. Sci., No. 10, 1: 40). The status of the Cedros Island forms has been difficult to determine because few specimens have been available.

I have now completed an examination and character tabulation of a

representative series of these horned toads, distributed as follows:

Central California	101
Southern California	179
Northern Lower California	41
Southern Lower California	54
Cedros Island	3
Total	378

Most of these specimens were adults; when sufficient numbers of adults were available from any area juveniles were not considered, since in the young the horns are so rudimentary that species differences are scarcely apparent.

That *blainvillii* and *coronatum* are closely allied there can be no question; the enlarged and pointed gulars which distinguish these species from others in the southwest, and a similarity in the arrangement of temporals and sublabials, indicate a close relationship. At the same time some differences between the two forms are readily evident; it remains only to determine whether there is a gradual territorial shift in these differences from one to the other, or an unfilled gap; and in either case how many regional races are to be recognized.

An initial survey of these differences indicates that the variations do not follow a logical geographic pattern; that is, the forms most widely separated territorially do not show the widest differentiation in characters. On the contrary the San Diegan specimens of *blainvillii* are more differentiated from the San Lucan *coronatum* than are the most northerly specimens of *blainvillii* from central California. These differences may be summarized as follows:

	coronatum (Cape Region)	*blainvillii* (S. D. Region)
1. Scales in frontal area	Black, flat, striated	Drab, convex, smooth
2. Occipital spines	Heavy, usually curving outward and upward	Narrow, usually straight
3. Inter-occipitals	Prominent	Small
4. Posterior temporals	Angle with center-line of body greater than 45°	Angle with center-line of body less than 45°
5. Anterior temporals	4th (counting forward)[2] prominent and sharp, pointing outward; much larger than next anterior (if the latter be present at all)	4th and 5th temporals of the same size, or the 5th slightly larger; both small and dull, insignificant compared with the posterior three
6. Supratemporals	Enlarged and pointed	Absent or rudimentary
7. Subrictal	Practically in line with sublabials like a sixth sublabial	Above the line of the sublabials and overlapping the 6th sublabial if it be present
8. Postrictal	Absent or rudimentary	Present

[2] This is really the 5th temporal but it would be confusing to refer to it as such, since the 4th is rudimentary or more often suppressed entirely, its position being indicated by a gap.

Of these items 1, 5, 7, and 8 are the most consistent and definite, although even in these we find territorial variations. Thus, as we go northward from the Cape to central Lower California, the temporal crown of spines of *coronatum* becomes less extreme in development; a postrictal [3] is usually present; the subrictal is above the line of the sublabials. Similarly, in *blainvillii,* outside of the immediate vicinity of San Diego, the frontals are flat, and striated or rugose. Yet even with these tendencies, when all the available specimens are arranged in territorial order from north to south, we do not find a gradual intergradation in all characters; on the contrary, there remains a definite break in several. This is particularly evident in the nature of the temporals, notably the 4th and 5th; in these all specimens of the two forms seem sharply separated, *coronatum* having a single outward pointing horn in this section (fig. 1), while *blainvillii* has two blunt spines of nearly equal size, directed backward (fig. 2).

Therefore, our first conclusion is that *coronatum* and *blainvillii* are distinct species. The most southerly available *blainvillii* are from the vicinity of Punta Prieta and the most northerly *coronatum* from near Calmallí in Lower California. About 60 miles separate these two points. It is hardly conceivable that more variation should occur in this short distance than in the 400 miles to the south or 1000 miles to the north. Whether there is an actual overlap in the territories occupied by the two forms will not be known until further collections are made in this area, but the possibility of intergradation appears remote indeed. This is further verified by the presence on Cedros Island of analogues of the two forms, as is subsequently discussed.

As to the division of these two mainland species into subspecies, we find the following: *P. blainvillii blainvillii* is a weakly differentiated subspecies centering about San Diego; it extends only from the San Bernardino Mountains, in San Bernardino County, south to extreme northern Lower California, where intergradation is shown with the next race to the south, at about Lat. 32° N. (San Miguel Mission and Ojos Negros). This San Diegan race differs from those adjoining it to the north and south in having smooth and usually convex frontal scales, whereas its neighbors have striated or rugose scales which are normally flat, but may be peaked. In fact, full differentiation is only evident in adult specimens, juveniles and subadults of both species generally having peaked and roughened head plates.

I have been unable to find any consistent differences between the populations lying to the northwest and to the south of the San Diegan area inhabited by *P. b. blainvillii.* Schmidt, in describing *nelsoni,* distinguished it from *frontale* by its possession of larger frontal scales and keeled scales on the vertebral line. With numbers of both forms for comparison, I do not find these differences consistent; some specimens from near the type locality of *frontale* in central California, are even more keeled on the vertebral line than those from near San Quintin, Lower California, and there is great variation in the size of the frontals. Similarly, the lower row of peripheral body scales is variable. As to the enlarged frontals, it is true, as might be expected, that specimens in proximity to *blainvillii* territory on either side

[3] The postrictal is just anterior to the lower tip of the aural slot.

have large frontals, for this is a character of *blainvillii* itself. But the more distant specimens of *frontale,* that is, those from the extreme north, are quite similar in the size, flatness, and roughness of the frontals to the specimens of *nelsoni* found in the southernmost areas reached by the latter. I therefore conclude that *nelsoni* is invalid and that *P. blainvillii frontale,* which must be the parent form of *blainvillii,* occupies two distinct areas separated by the mildly differentiated race, *P. blainvillii blainvillii.* These two areas are: (1) California (west of the Sierra Nevada), from San Francisco and Kennett south to the coastal plain in Los Angeles and Orange counties; and (2) Lower California (west of the Sierra de Juarez and Sierra San Pedro Mártir) from Lat. 32° N. south to Lat. 29°. As to Terron's *ochoterenai,* the describer's photographs show clearly that the type is a specimen of our common southern California horned toad, *P. b. blainvillii,* such as would be expected in the vicinity of Tecate. The temporals, subrictal, and postrictal afford a positive identification. The frontals seem slightly peaked but this is not unusual anywhere in *P. b. blainvillii* territory, particularly in young specimens.

It is important to note that the most southerly available specimens of *frontale,* that is, those from near Punta Prieta and El Marmol, seem to be no nearer *coronatum* than are those from around San Francisco; in other words, there is, in *frontale,* no consistent territorial tendency to vary toward the species occupying the area next to the south.

In *coronatum* this situation does not obtain, for here the northerly specimens do show *blainvillii* (or *frontale*) tendencies as compared to individuals from the type locality. When we compare individuals from San Ignacio and Calmallí, in central Lower California, with others from the Cape region, we find the temporal crown less prominent and a postrictal often present. Thus, while intergradation with *frontale* is not evident, we conclude that *jamesi* is a valid subspecies of *coronatum.* Intergradation between the two races occurs between Mulegé and Comondú; just where cannot be determined as specimens are not available from this stretch. However, that the two forms intergrade cannot be doubted from the extent and character of the variations shown in available specimens collected north and south of the gap; at best *jamesi* is only a moderately differentiated subspecies of *coronatum.*

Having discussed the characteristics of *coronatum* and *blainvillii,* I desire to return once more to the matter of the probable type localities of these two forms, which affect the applicability of the names as they are currently used.

I forwarded to M. F. Angel of the Paris Museum, sketches showing typical San Diegan and Cape specimens, accentuating especially the differences in the temporals. He courteously advised me that de Blainville's type of *coronatum* is certainly of the southern form; in addition it has no postrictal. Thus there can be no doubt that Botta secured this specimen in the Cape region of Lower California, where he is known to have collected. This fully verifies Stejneger's conclusion reached in 1893.

Mr. H. W. Parker has been kind enough to examine the type specimen

of Gray's *blainvillii* in the British Museum and reports that it is undoubtedly of the northern form, possessing both 4th and 5th temporals, and a postrictal. The head scales are convex and slightly rugose, thus verifying the rather poor figure in "Zoology of Beechey's Voyage." Hence there is no doubt that *blainvillii* is the proper name for the coastal horned toad of upper California, as had been previously pointed out by Stejneger and Van Denburgh. But it is much less certain whether this name should be applied to the subspecies from the vicinity of San Diego currently referred to as *P. b. blainvillii* or that of central California, which modern authors refer to as *P. b. frontale.*

It might first be assumed that the type must have come from central California since Beechey visited San Francisco and Monterey but not San Diego. But as a matter of fact the type of *blainvillii* was not secured by the Beechey Expedition at all, although described in the monograph of that voyage; it was collected by Botta, just as was the type of *coronatum,* and was given to Gray by de Blainville, which explains why it was so named. Now, Botta collected not only at the Cape but also at San Diego and other points in upper California. He was in San Diego in April (1827), and horned toads are most plentiful at this time of year. That he must have secured some of his specimens from the immediate vicinity of San Diego is proved by his having collected *Lampropeltis californiae* in its most typical pattern, a form with an extremely limited range centering in San Diego. Therefore, while the type of *blainvillii* is a young specimen only 62 mm. in length, which cannot show conclusively the differences in the frontal plates which distinguish *P. b. blainvillii* from *P. b. frontale,* it is to be observed that they are convex and there is better than an even chance that the specimen did come from near San Diego. At any rate, in the face of this uncertainty Van Denburgh may be assumed to have designated the type subspecies and *P. b. blainvillii* is retained as the proper name for the San Diegan race.

There remain the two Cedros Island forms, *cerroense* and *schmidti.* The former is clearly an offshoot of *coronatum,* distinguished therefrom by a weaker temporal crown and an unusually large nostril. Only two specimens have been collected, the type, USNM 11977, and a second, kindly presented to me by Major Chapman Grant.

Dr. Doris M. Cochran has been good enough to examine the type for me and has confirmed the differential characters which are evident in the Grant specimen, namely the large nostril, weak lower lateral fringe, and relatively prominent fourth (or fifth) temporal.

Of *schmidti,* four specimens have been taken; I have seen two, a juvenile and a subadult. Mr. Benjamin Shreve has kindly examined the type and reported on certain critical points, and there remains no doubt that *schmidti* differs essentially from *cerroense,* as stated by Barbour. *P. schmidti* is an island analogue of *blainvillii,* and is in fact so similar to the mainland race, *P. b. frontale,* that I am unable to find consistency in the character differences which Barbour has employed in distinguishing it from the mainland form. His comparisons were evidently made with *P. b. blainvillii* of

the San Diegan area, and with these some of the characters do hold. But when compared with specimens of *P. b. frontale* from north-central Lower California, that is, the mainland habitat of the subspecies of *blainvillii* nearest Cedros Island, I find such variability in all of these characters that subspecific differentiation of *schmidti* appears unwarranted; at least until numbers of island specimens are available and it can be shown that there are average differences more than sufficient to controvert the individual variations which are apparent. Possibly the direction of the head spines (the post-temporals and occipitals), which lie flat along the body in the subadult paratype of *schmidti* which I have seen, is the most consistent differential character of *schmidti;* but while most specimens of *frontale* have these horns conspicuously elevated, this is not always true. Also it is a character which becomes accentuated with age.

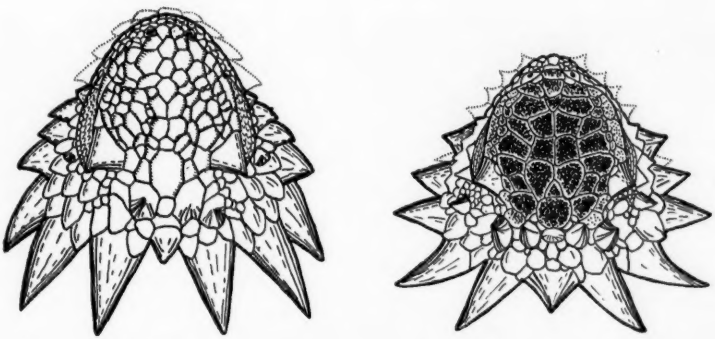

Fig. 1. *Phrynosoma coronatum coronatum*
(sublabials dotted to avoid confusion with temporals).
Fig. 2. *Phrynosoma blainvillii blainvillii.*

The fact that both *coronatum* and *blainvillii* are represented by allies or subspecies on the small island of Cedros and still retain their individualities, may be taken as confirmation of the specific separation of these two forms on the mainland.

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Summary and Key

The Pacific Coast horned toads allied to *Phrynosoma coronatum* may be divided into the following species and subspecies:

Phrynosoma coronatum coronatum (Blainville), 1835

Cape region of Lower California north to Lat. 26° N.

Phrynosoma coronatum jamesi Schmidt, 1922

Central Lower California between Lat. 26° N. and Lat. 28½° N.

Phrynosoma cerroense Stejneger, 1893

Cedros Island.

Phrynosoma blainvillii blainvillii Gray, 1839

Southern California and extreme northern Lower California west of the desert from southwestern San Bernardino County, California, south to Lat. 32° N.

Phrynosoma blainvillii frontale Van Denburgh, 1894

California, west of the Sierra Nevada, from the San Francisco Bay region and the northern Sacramento Valley to the Los Angeles basin; also northern Lower California west of the Sierra de Juárez and Sierra San Pedro Mártir, from Lat. 32° N. south to Lat. 29° N.; also Cedros Island.

The following forms are placed in synonymy:
Phrynosoma schmidti Barbour, 1921. Synonym of *P. b. frontale.*
Phrynosoma nelsoni Schmidt, 1922. Synonym of *P. b. frontale.*
Phrynosoma ochoterenai Terron, 1932. Synonym of *P. b. blainvillii.*

Key

A Fourth (or fifth) temporal horn (counting forward) sharply pointed and greatly exceeding fifth (or fourth) in length
- B Nasal orifices large; distance between inner edges less than 1¾ times maximum orifice diameter ..... *P. cerroense*
- BB Nasal orifices moderate; distance between inner edges more than 1¾ orifice diameter
  - C Postrictal spine absent or rudimentary .. *P. coronatum coronatum*
  - CC Postrictal spine present ..... *P. coronatum jamesi*

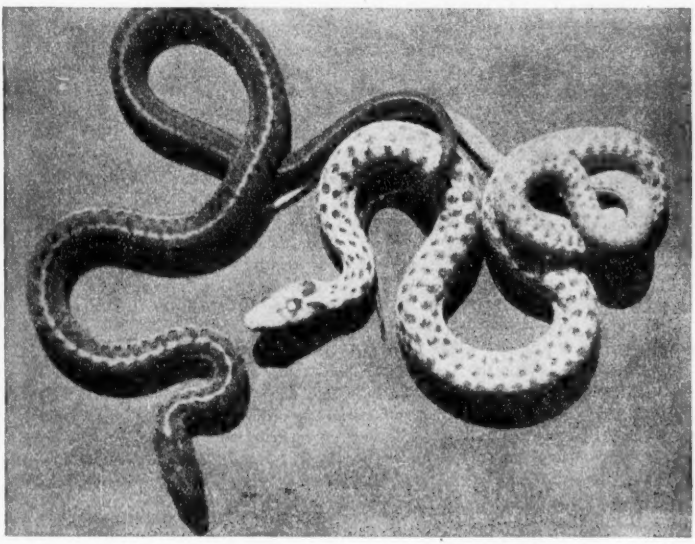
AA Fourth and fifth temporal horns dull; of nearly equal size or the fifth slightly larger
- B′ Frontal plates in adults smooth and convex ..... *P. blainvillii blainvillii*
- BB′ Frontal plates in adults rough, striated or rugose, and flat or peaked ..... *P. blainvillii frontale*

San Diego Society of Natural History, San Diego, California.

Herpetological Notes

AN ABNORMALLY COLORED GARTER SNAKE.—Through the courtesy of Mr. J. F. G. Clarke an abnormally colored garter snake (*Thamnophis ordinoides vagrans*) collected at Bishop, Washington, by Laverne Dressler on June 2, 1934, was presented to the Charles R. Conner Museum of the State College of Washington.

Basing the color terminology on Ridgway's "Color Standards and Color Nomenclature," the specimen when alive appeared as follows: instead of olive the ground color was light, drab gray providing very little contrast with the white dorsal and lateral stripes; the usual numerous dark brown or near black spots which cover several scales as well as the proximal ends of the gastrosteges varied in shade from Natal Brown near the head to Allevaneous in the tail region, presenting a gradual dilution of this shade of brown posteriorly. The contrast between these brown spots and the very light background gave this snake a decided tessellated appearance strikingly unlike the normally colored individuals. The Natal Brown color was also present on the posterior ends of the parietals as well as on the scales of the upper ends of the jaws. The color of the iris of the eye was Grenadine Red instead of the usual dark brown or black (Fig. 1). This snake appeared normal in all respects except coloration.



Abnormally colored garter snake (left), contrasted with normally colored one (right).

The recent article in COPEIA by Clay (1935) describing the occurrence of albinos in a brood of the common water snake (*Natrix sipedon sipedon*) presents a case where the albinism was evidently brought about by a single genetic factor. This, however, cannot explain the abnormal coloration in the present case, for several factors seem to be involved. The factor responsible for the normal olive color is absent since the ground color is Light Drab Gray. The deposition of the brown pigment is perhaps brought about through the interaction of several factors, one of which has to do with the intensity of deposition and is evidently not functioning to its fullest extent, since the spots have been diluted to a brown instead of being almost black. Another factor must be present in normal garter snakes which involves the even distribution of this dark brown pigment, since the black spots in normal snakes are equal in hue irrespective of where they happen to be located on the snake, whereas in this specimen the brown

varies from a Natal Brown in the head region to an almost complete absence of this pigment or Allevaneous in the tail. Another factor is evidently present which deals with the coloration of the iris of the eye since in the abnormal garter snake the iris was Grenadine Red instead of almost black. Therefore it is possible that coloration in these reptiles may be due to multiple factors all of which must be present in the dominant state for the normal pigmentation and coloration of the species. If one may assume that the inheritance of pigmentation in garter snakes is brought about by factors similar to those in mammals, then this abnormally colored garter snake may be considered to be a "pink-eyed-dilute."

Since in this case as well as in the abnormally colored snakes described by Clay (COPEIA, 1935), Storer (COPEIA, 1916), and others mentioned in literature, the general color pattern is always present, if not always pigmented, may it not be that this "fundamental character" of pattern is determined by the cytoplasmic makeup of the species rather than by any gene action?—ARTHUR SVIHLA, *Washington State College, Pullman, Washington.*

HIBERNATION AND MIGRATION OF THE SPOTTED TURTLE, *CLEMMYS GUTTATA* (SCHNEIDER).—Under date of April 3, 1936, Mr. Albert W. Davis, formerly an assistant in the Section of Recent Invertebrates of the Carnegie Museum, wrote to me as follows: "While driving to work between Chester and Newburgh in Orange County, New York, I observed the migration of a number of turtles. They were moving north. In the space of about one mile I observed some four turtles going in the same direction across the road. They were medium size with very dark shells, practically black, spotted with small yellow dots. I stopped to examine one which had been hit by a car. The terrain was fairly flat, and from a farm woodland on one side they were moving across to similar fields, although there was a shallow swamp in the direction they were headed. The interesting point was that all these turtles were moving on the same day, in the same general direction at almost the same time, about 10:00 A.M. of a warm spring day around April the first."

Mr. Davis' description leaves little doubt that the turtles which he observed were spotted turtles, *Clemmys guttata* (Schneider). The interesting part of this observation, however, is the very definite evidence that the turtles had hibernated in an upland situation and were migrating to the small swamp mentioned. Numerous writers refer to the social proclivities of this species, which tends to assemble, sometimes in large numbers, in sphagnaceous areas or on logs, and several writers[1] state that the species hibernates in mud. So far as I am aware no observer has previously mentioned a spring migration of the spotted turtle from high ground to a swamp or bog. In Pymatuning Swamp, Crawford Co., Pennsylvania, where the species is common, I have observed many specimens on the banks of drainage ditches and on patches of sphagnum in May and June, but I have not observed any migration from the timbered swamp "islands," or from the surrounding farms to the wetter situations. Persons who live in regions where the spotted turtle occurs may be able to contribute additional evidence which will settle the question of whether the species normally hibernates in mud or in dry ground surrounding swampy areas.—M. GRAHAM NETTING, *Carnegie Museum, Pittsburgh, Pennsylvania.*

BREEDING OF *PSEUDEMYS ELEGANS* IN CALIFORNIA AND NOTES ON OTHER CAPTIVE REPTILES.—In 1927 we purchased 14 young *P. elegans* about the size of fifty cent pieces at a local pet store. Last year the pond was so crowded that we liberated two of them below Sweetwater dam, two on the Linda Vista mesa and eight in Balboa Park. One pair was retained in a pond about ten feet in diameter in our patio. The female now weighs 3¼ pounds; the carapace measures 8 by 6½ inches. The male is considerably smaller. His most noticeable attributes are long front toe nails and a longer tail.

About the first of March of last year the male started a peculiar courting dance in the water. He would place himself in front of the female and wave his fore feet, nails held together, in her face, exactly as a mesmerist is purported to do. He would then

[1] Burroughs, John. 1875 (but 1914 ed.). Squirrels and other fur-bearers: 139, and Smith, W. H. 1882, Rept. Geol. Surv. Ohio, 4, part 1: 661.

swim around her and resume his hand waving in front of her. This lasted on and off for a considerable part of each day until about March 25 when the female became restless and would leave the pond to wander about the patio. When picked up to be thrown back into the pond she would pass a quantity of clear fluid.

At 5:30 P.M., April 8, the female was seen just outside the pond in dry firm dirt, digging a hole with the hind feet—one foot at a time. The hole was about an inch and a half in diameter at the top and about two or three at the bottom and about five deep. There was no evidence of any dirt having come out of the hole, but the surface appeared moist as if she had wet it.

She felt around the hole with one hind leg and then the other, withdrew both legs and dropped an egg. After this she again felt around in the hole with alternate hind legs about six times each and laid another egg. She appeared to be packing the eggs in or covering them separately. About eight eggs were laid. At 7:00 P.M. she started filling the hole with her hind feet, scraping in dirt that had apparently not come out of the hole. The feet were used alternately. During all this process her head was half hidden in her shell and she paid no attention to a flash light and spectators. She now reached farther with her hind feet and covered the site with dead leaves so that it was indistinguishable and then returned to the pond. The nest was not touched, but a screen wire fence placed close about it.

On May 20 the male was again courting the female.

For a week after making the first nest the female was observed digging more nests, probably urinating to soften the ground, as described by Taylor,[1] since the soil was much moister than it would have been from the water carried by the shell from the pond. No actual laying was observed in any of these nests, nor were the exact localities marked. On October 4 a torn egg shell was found on the site of the first nest, and immediately under it a baby turtle, 28 x 30 mm., lay buried. It was re-covered and a dish of water was sunk to the ground level near by. On October 10 the young turtle was found buried under about two inches of loose soil near the nest. The nest was not disturbed as the other eggs appeared sound. One of the later nests was found near by and proved to contain six collapsed eggs.

In the same pond are six spotted turtles, two local pond turtles, a number of sunfish, black bass and mosquito fish and a four-foot alligator which we secured in 1930 when about a foot long. It hibernates in a joint of six-inch cement pipe at the bottom of the pond from January to the end of March and remains under for a week or so at a time before and after these months during cold weather.

In the patio there are several *Terrapene carolina* and *T. ornata* which keep hidden most of the time. While cultivating a tree last year several eggs were unearthed broken, containing well developed embryos of one of these species.—CHAFFEE GRANT, *3694 Jackdaw St., San Diego, California.*

TWO INTRODUCED LIZARDS IN MIAMI, FLORIDA.—While visiting Dr. David Fairchild in Coconut Grove I went with him to visit Mr. C. A. Mosier, an authority on the fauna and flora of southern Florida. He showed me two lizards which had been found by some of the students of Mrs. Palmer, teacher of Biology in the Edison High School in North Miami.

One of these lizards I guessed to be *Hemidactylus turcicus*,[1] a species apparently established in Key West. The identity has been confirmed by Mr. Benjamin Shreve at Cambridge. No less than five specimens of this gecko have been recently found in a limited area in North Miami.

The other lizard was a *Leiocephalus* and Mr. Shreve writes me that he suspects it represents *L. c. virescens* which Dr. Stejneger described from Green Key. I confess that the presence of this race in the outskirts of North Miami puzzled me completely, until it occurred to me that last year at the Opalocka Zoo I saw several cages full of Leiocephali which someone had brought back from some of the smaller Bahama islands.

I only put this find on record because its first appearance is worth recording in the event that it establishes itself.—THOMAS BARBOUR, *Coconut Grove, Florida, March, 1936.*

[1] Edward H. Taylor, Arkansas amphibians and reptiles in the Kansas University Museum. Univ. Kans. Sci. Bull., 22 (10), 1935: 216.

[1] Cf. Stejneger, COPEIA, 108, 1922: 56.

RHADINAEA FLAVILATA (COPE) IN TEXAS.—In checking over a collection recently presented to the Carnegie Museum by Dr. D. A. Atkinson I encountered a single example of *Rhadinaea flavilata* (Cope). This specimen, CM 8937, was collected near Clifton, Bosque Co., Texas, on May 27, 1916, by E. B. Williamson and D. A. Atkinson. I feel that it is difficult to question the derivation of this specimen since it was received in a jar which contained, in addition, 1 *Opheodrys,* 12 *Potamophis,* 19 *Sonora,* and 45 *Tantilla.*

Stejneger and Barbour[1] list the range of *Rhadinaea flavilata* as "The Carolinas to Florida" in spite of the previous publication by Blanchard[2] of a more accurate range; namely, "North Carolina to Florida and Mississippi." The species is also known to occur in eastern Louisiana, but the present specimen extends its known range from the Mississippi River across all of western Louisiana and 200 miles into Texas. Furthermore it extends the range to the extreme limit of the Coastal Plain in central Texas.

The specimen is a female, which has a total length of 307 mm., and a tail length of 89 mm. The scutellation may be summarized as follows: dorsal scale rows, 17, but an additional row is present on the left side for about one inch behind the head; ventrals, 131; caudals, 65; praeoculars, left fused to supraocular, right normal; postoculars, 2–2; supralabials, 7–7; infralabials, 9–9; anal divided. The scutellation agrees closely with that of a specimen, CM 5240, from near Biloxi, Mississippi, but the Texas specimen is uniformly lighter in color.—M. GRAHAM NETTING, *Carnegie Museum, Pittsburgh, Pennsylvania.*

THE GENERIC NAME OF A SOUTH AFRICAN OPHIDIAN.—In the COPEIA just received (1936, 1: 70) I notice that a new name, *Sepedonophis,* is proposed for *Sepedon* Merrem, 1820, preoccupied by *Sepedon* Latreille, 1804. I regret to say that two names are already available for the genus, viz. *Hemachatus* Fleming, *Philos. Zool.,* 2, 1822: 295 (type *H. vulgaris*) and *Merremia* Berg, *Comm. Mus. Buenos Aires,* 1: 291 (substitute for the preoccupied *Sepedon*). The proper name of the species would seem to be *Hemachatus haemachatus* (Lacépède).—LEONHARD STEJNEGER, *U. S. National Museum, Washington, D. C.*

THE OCCURRENCE OF *BUFO PUNCTATUS* IN KANSAS.—The first record of *Bufo punctatus* Baird and Girard in Kansas was of a single specimen taken in Morton County, July, 1927, by W. H. Burt and H. C. Parker. (Hill, Science, 74, 1931: 547–548). A second specimen was taken September 5, 1933, by C. W. Hibbard and H. M. Smith in Schwartz Canyon, Comanche County, in the head of a small tributary of Schwartz Canyon about noon, where it was observed hopping about in a densely shaded area (Smith, Am. Mid. Nat., 15 (4), 1934: 446–449).

The spotted canyon toad was considered a rare form in Kansas until recently, when a party from the Museum of Birds and Mammals of the University of Kansas spent several days collecting in Barber County. A single specimen was picked up near the entrance to Dancer's Cave, four miles south of Sun City, about 1 P.M. after a shower of rain, on August 27. It continued to rain in showers that afternoon, and the temperature soon dropped to around 70°F. Later that afternoon the party moved to a series of caves on a branch of Mule Creek six miles north of Aetna. Near a chimney in one of these caves several specimens of *Bufo punctatus* were taken, in association with *Rana pipiens, Bufo woodhousii woodhousii,* and *Ambystoma tigrinum mavortium.* The weather remained damp and cool, and during that afternoon and evening a considerable series of *punctatus* was secured in the grass around the entrances to the caves. Another specimen was taken on August 29, five miles south of Aetna near the Oklahoma-Kansas state line, south of the Salt Fork River. In all, fifty specimens of *Bufo punctatus* were taken, ranging from adults to small immatures, which indicates that this toad is not rare in this part of Kansas.

Thanks are due Mr. Charles D. Bunker, Acting Curator in Charge, Museum of Birds and Mammals, The University of Kansas, who made this expedition possible.—C. W. HIBBARD and A. B. LEONARD, *Department of Zoology, University of Kansas, Lawrence, Kansas.*

[1] Stejneger & Barbour, Check List of North American Amphibians and Reptiles, 3rd. ed., 1933: 105.
[2] Blanchard, F. N., Key to Snakes of the United States, Canada, and Lower California, 1925: 41.

THE CORRECT NAME FOR THE NORTHERN DIAMOND-BACK TERRAPIN.—In Conant and Bailey's recent paper (Occ. Pap. Mus. Zool., Univ. Mich., 328, March 31, 1936: 9) I notice that they are following Lindholm's example (1929) in substituting *Malaclemys terrapin terrapin* (Schoepff, 1793) for *Malaclemys centrata concentrica* (Shaw). Dr. Lindholm at the time was evidently unaware of the fact that Schoepff's species (not the specimen from Long Island described and figured) and its name was based on the same Jamaican reference which served as the base for Lacépède's *Testudo terrapen* (Hist. Nat. Quadr. Ovip. Serp. 1, 1788: synops. méth. between pp. 618–619), the same which also served as the base for the one year younger name *Testudo palustris* Gmelin. Schoepff considered his Long Island specimen as identical with Lacépède's species and his *Testudo terrapin*, therefore, cannot be applied to the northern form of our diamond terrapin, the correct name of which is that given in the third edition (1933) of the *Check List of North American Amphibians and Reptiles:* 144.—LEONHARD STEJNEGER, *United States National Museum, Washington, D. C.*

A NOTE ON THE ECOLOGY OF *MICROHYLA OLIVACEA*.—An interesting relationship exists between the brevicipitid frog *Microhyla olivacea* (Hallowell), of the southwestern prairies, and a large tarantula or running spider, *Eurypelma* (*Dugesiella*) *hentzi* Girard, of the same region.

The tarantula lives in a burrow varying in depth from 12 to 30 inches. The entrance to the burrow is usually located at the edge of a stone, or the burrow may run back horizontally under the stone, then go down vertically beneath it.

More than 100 tarantula burrows were examined in Tulsa County, Oklahoma, during July and August of 1935. About 75 per cent of them were found to have from one to several *Microhyla* apparently living in perfect harmony with the owners. One burrow yielded nine of the frogs and a large, female tarantula. Most of the burrows, however, contained from one to three frogs and one tarantula. Some of the burrows in which the frogs were not found may have contained them, as it was sometimes impossible to follow the tunnels to the end when they penetrated beneath deeply imbedded rocks. The frogs and the tarantula as well were sometimes found in the runways beneath a rock. When the rock was overturned all would make a dash for the entrance to their subterranean retreat.

Some of the frogs were found beneath stones that did not have tarantulas or tarantula burrows under them. The majority of the frogs found were, however, taken in association with the tarantulas and their burrows, and in very dry weather they were found nowhere else.

It seems probable that in the burrows of the tarantula the frogs find protection from the heat and drought of summer. Possibly also the presence of the tarantula affords the frogs protection against some of their enemies. There is no evidence of the tarantula deriving any benefit from the presence of the frogs.—W. FRANK BLAIR, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

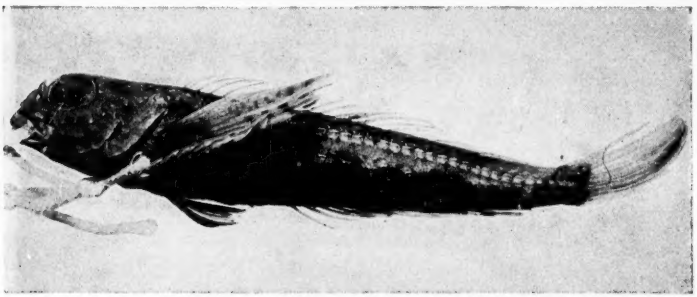
MICROHYLA CAROLINENSIS IN NORTHEASTERN TENNESSEE.—Carter (COPEIA, 1934, 3) recorded *Gastrophryne carolinense* from Fulton County, Georgia, and suggested that this species has invaded the piedmont there by way of the Chattahochee River valley.

Two localities in northeastern Tennessee represented by specimens in the Museum of Zoology, University of Michigan, are evidence that invasion from the costal plain is more extensive than has been noted previously. On September 9, 1934, Dr. J. M. Valentine, Mr. R. M. Bailey, and I collected two specimens near Bluff City, Sullivan County, Tennessee. Both specimens were found under a large log on a dry ridge covered with red cedar. Two other specimens were taken by Mr. Berry Campbell on June 8, 1933, near Kingsport, Sullivan County, about 20 miles west of the first locality.

Both localities are physiographically within the Great Valley, a limestone region marked here by numerous sinks and caves. The altitude is about 1500 feet. The species probably is to be found throughout the Great Valley in Tennessee, and should be looked for in southwestern Virginia where this province enters the state.—JOSEPH R. BAILEY, *Museum of Zoology, Ann Arbor, Michigan.*

Ichthyological Notes

ON THE GOBIESOCID GENUS *RIMICOLA*.—On May 3, 1935, Dr. J. L. Hart took 4 specimens of the gobiesocid genus *Rimicola* at Round Island Flats, Clayoquot Sound, British Columbia, in shallow water. This collection is rather unique since it is the first record of the genus north of Monterey, California.



The type specimen of *Asemichthys taylori* Gilbert. Photograph kindly supplied by the Museum of Natural History, Stanford University.

All of the individuals were vivid green without indication of any spotting or other color as in the type of *R. muscarum*. The smallest and the largest specimens are males, with elongate, pointed genital papillae; the two females have genital papillae which are shorter than those of the males, and rounded at the tips. In the males the vent is more anterior in position than in the females, and a distinct groove, interrupted by the vent, extends from the disk to the anal fin. In the females there is no ventral groove but there is a distinct low ridge between the vent and the anal fin. The pelvic disk is both longer and wider in the males than in the females, and the head seems to be somewhat larger (Table 1).

TABLE 1. BODY PROPORTIONS AND FIN RAYS OF 4 SPECIMENS OF *RIMICOLA* FROM VANCOUVER ISLAND

Sex	Male	Male	Female	Female
Standard length	25.5 mm.	36.5 mm.	29.0 mm.	32.0 mm.
Proportionate measurements in hundredths of standard length:				
Head length	27.4	27.4	25.8	26.6
Body depth	9.6	12.4	12.1	11.0
Eye diameter	3.9	4.4	5.3	4.7
Interorbital width	9.6	9.6	10.4	10.3
Maxillary length	5.9	6.0	6.9	6.9
Caudal fin length	15.4	...	13.6	15.6
Pectoral length	13.0	12.6	12.4	12.5
Disk length	17.7	18.4	15.6	15.6
Disk width	13.8	13.7	10.4	11.0
Snout to dorsal	74.6	74.1	72.5	73.5
Snout to anal	70.5	69.9	70.7	71.9
Snout to vent	58.8	58.8	62.0	62.5
Anal fin in advance of dorsal	3.9	4.1	1.7	1.6
Anal papilla length	3.5	4.1	1.7	1.6
Dorsal fin rays	6	5	5	5
Anal fin rays	5	5	5	5

The characters of the specimens from the west coast of Vancouver Island (Table 1) are common to the types of both *Rimicola eigenmanni* (Gilbert) and *R. muscarum* (Meek and Pierson), for the males agree most closely with *R. eigenmanni*, while the females agree with *R. muscarum* as originally described, except in the color and coloration, which are known to vary greatly in this species, as in most reef fishes. Therefore, the reference of *Gobiesox muscarum* Meek and Pierson (1895) to the synonymy of *Rimicola eigenmanni* (Gilbert, 1890) by Snyder[1] is confirmed.—G. V. Wilby, *Pacific Biological Station, Nanaimo, British Columbia.*

[1] Proc. U. S. Nat. Mus., 35, 1908: 183.

A SECOND RECORD OF THE COTTOID FISH *ASEMICHTHYS TAYLORI* GILBERT.—During the summer of 1935, the Canadian Hydrographic Survey generously made available accommodations on the survey vessel, the *Wm. J. Stewart*, for a chemist and a biologist from the Pacific Biological Station. Dr. C. McLean Fraser of the Department of Zoology, University of British Columbia, accepted the invitation to accompany the vessel as biologist and made extensive collections from June 1 to the latter part of July, during the operations of the *Stewart* around the Queen Charlotte Islands. The collection of fishes has been made available to the writer for study.

On June 27, in a bottom dredge haul at a depth of from 7 to 25 fathoms, a male specimen of *Asemichthys taylori* Gilbert was taken together with two other cottoids, *Tarandichthys tenuis* and *Hemilepidotus hemilepidotus*, in Tasoo Harbor, Moresby Island (52° 44′ N. Lat., 132° 07′ W. Long.). This is the second specimen of the species on record. The type, a female, was taken in Departure Bay, Vancouver Island, and was described in 1912 by Gilbert.[1]

Dorsal rays X–17; anal, 17; pectoral, 17; pelvic, I, 3. Lateral line plates, 36.

Measurements in hundredths of the standard length (44.5 mm.): depth of body, 16.9; depth of caudal peduncle, 4.5; length of head, 31.5; width of head, 22.5; length of snout, 7.9; length of eye, 9.0; length of upper jaw, 9.5; length of pectoral fin, 33.6; length of pelvic fin, 18.0; length of base of anal fin, 38.0; length of caudal fin, 21.3; distance from tip of snout to origin of dorsal fin, 30.3; length of base of spinous dorsal fin, 20.2; length of base of soft dorsal fin, 35.8; distance from tip of snout to insertion of pelvic fins, 28.0; from tip of snout to anus, 41.5; length of genital papilla, 9.0.

A comparison of these measurements with those of the type shows some slight differences. In the male the head is slightly wider than in the female and the maxillary reaches only to the front of the orbit, rather than to the point vertically below the front of the pupil. In addition to the small triangular, upwardly directed spinous process near the upper edge of the preopercle, there is in the male a smaller partially hidden spine located about one diameter of the pupil below the main spine. In the male a series of 7 or 8 small horny projections, similar to those found in the agonids of the genus *Asterotheca*, pass longitudinally across the eyeball, about midway between the upper edge of the orbit and the pupil. The teeth are villiform as in the female but the outer row of teeth is enlarged on each jaw in the male. The anus is more anterior in position in the male, and the least depth of the caudal peduncle is only about ⅔ that given for the female.

This specimen is deposited with the *Wm. J. Stewart* collections at the Pacific Biological Station.—G. V. WILBY, *Pacific Biological Station, Nanaimo, British Columbia.*

THE UNBARRED PHASE OF THE CALIFORNIAN SURF-FISH, *AMPHISTICHUS ARGENTEUS*.—That the Surf-fish (*Amphistichus argenteus* Agassiz) of the California coast, which in typical coloration is conspicuously barred, occurs as well in a unicolored phase has been noted by Jordan and Evermann.[2]

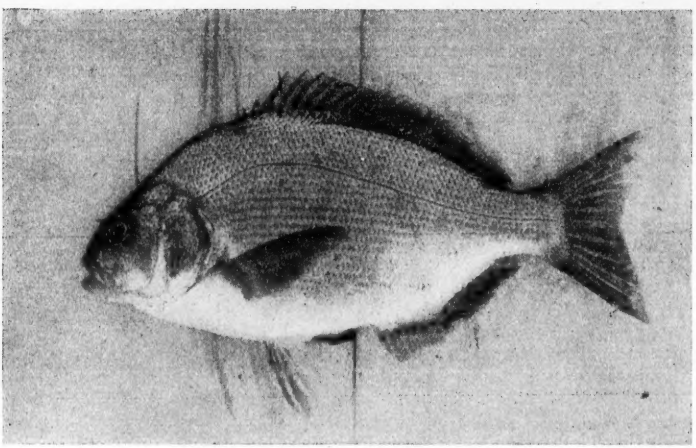
Of the total 17 specimens of this species which I have taken, 2 have been of this unicolored phase. However, with such a small series as a basis, it is doubtful whether this proportion may be considered representative, and from my observation of the catches of other anglers, upon which I have kept no data, I should expect to find that the unbarred phase of this species does not occur as frequently as these figures would indicate.

The accompanying photograph shows the first of these two unicolored specimens, which I obtained September 11, 1927, at Rodeo Cove, north of Point Bonita, Marin County, California.

I secured the second unicolored specimen December 29, 1935, from the south shore of Alameda, California, west of Neptune Beach. It has been deposited in the Museum of Zoology, University of Michigan (Cat. No. 109990).

The life colors of these two examples of the unbarred phase were uniform olive above and silvery below, without bars or spots. The vertical fins were dusky and the

[1] Gilbert, Charles H. A new genus and species of cottoid fish from Departure Bay, Vancouver Island. *Contr. Can. Biol.*, 1906–1910 (1912): 215–216.



Unbarred phase of *Amphistichus argenteus*
Rodeo Cove, Marin County, California

ventrals somewhat dusky toward the tips.

The unbarred phase is apparently identical with the type form except in its seemingly mutant coloration.—W. I. FOLLETT, *Central Bank Building, Oakland, California.*

A NOTE ON THE STEPHANOBERYCID FISHES.—Pending further studies on the classification of the berycoid fishes, it seems best to place on record a nomenclatural correction in the Stephanoberycidae. *Stephanoberyx monae* was described by Gill in 1883 (Proc. U. S. Nat. Mus., 6: 258). In 1895 (Oceanic Ichthyology: 187) Goode and Bean added a second species, *S. gillii,* and they quote Gill as having first proposed the family name Stephanoberycidae in the Standard Natural History (3, 1885: 182). On beginning an examination of these fishes, it was evident at first sight that *Stephanoberyx gillii* is generically distinct from *S. monae.* Study of the literature, however, shows that Gill, in an almost forgotten paper puplished as early as 1884 (Am. Nat., 18: 433), not only proposed and defined the new family Stephanoberycidae but also succinctly diagnosed and named as a new genus and species the fish described 11 years later by Goode and Bean as *Stephanoberyx gillii.* Besides *Malacosarcus* Günther (Challenger Reports, Zool., 1887: 30), which Regan (Ann. and Mag. Nat. Hist., (8) 7, 1911: 9) places in the Stephanoberycidae, the family includes two species, *Stephanoberyx monae* Gill, 1883, and *Acanthochaenus lutkenii* Gill, 1884. The latter, of which *S. gillii* Goode and Bean is a synonym, differs sharply from *Stephanoberyx* in its abdominal pelvic fins, the shorter and much more posterior dorsal and anal fins, the much shorter premaxillaries, the branched fin rays, the presence of but 1 or 2 (rarely 3) spines on each scale versus 4 or 5 in *S. monae,* and the form and position of the spiniferous ridges of the skull.

Gill listed no type specimens of *Acanthochaenus lutkenii,* although it is probable that he saw all of the material in the National Museum at the time. One of these specimens (U. S. N. M. 33555) was entered in the catalogue as the type of *A. lutkenii* and I now wish to designate this as lectotype of the species. This is the identical specimen that was used later by Goode and Bean as the holotype of *Stephanoberyx gillii.*

Despite the strong dorsal spines of *Gibberichthys pumilus* Parr (Bull. Bingham Oceanogr. Coll., 3 (6), 1933: 5; and 4 (6), 1934: 35), I cannot believe that this peculiar fish belongs anywhere but near the Stephanoberycidae.—GEORGE S. MYERS, *U. S. National Museum, Washington, D. C.*

[1] Bull. U. S. Nat. Mus., 47 (2), 1898: 1503–1504.

ON *CARANX IGNOBILIS* (FORSKÅL).—The widely distributed Indo-Pacific *Caranx* characterized by a small patch of scales in the center of its otherwise scaleless breast is identified with *Scomber ignobilis* Forskål, 1775, according to the following brief synonymy.

Caranx ignobilis (Forskål)

Scomber ignobilis Forskål, "Desc. Anim.," 1775: 55 (Red Sea).

Caranx lessonii Cuvier and Valenciennes, Hist. Nat. Poiss., 9, 1833: 113 (Nouvelle-Hollande).

Caranx carangus Day, Fauna Brit. Ind., Fishes, 2, 1889: 153; etc.

It has a representative species in the Atlantic (found also on the west coast of America), *Caranx hippos* (*Scomber hippos* Linnaeus, Charleston, South Carolina), with which *Scomber carangus* Bloch (Antilles), type of the genus *Caranx*, is conspecific.

Weber and de Beaufort, 1931,[1] recognize three allied species, with breast squamation as in *C. ignobilis*, from the Indo-Australian archipelago,—*ignobilis*, *sansun* Forskål, and *carangus* Bloch, cosmopolitan. It is probable, however, that they have misidentified *sansun* and *carangus;* and whereas the *ignobilis* group is doubtless variable and I have seen no material from the Indian Ocean, Atlantic material (and that from the west coast of America), and Pacific material examined is referable to *hippos* with its race *tropicus* Nichols (possibly a synonym of *carangus* Bloch), and to *ignobilis* respectively; other species differentiated in the literature are not convincing.

Some recent authors restrict this genus *Caranx* to the few forms with like breast squamation, but *Caranx sexfasciatus* Quoy and Gaimard with breast completely scaled is obviously closely related to them as species of *Caranx* go, and this character seems to have no great evolutionary importance in this group.

On both shores of America *C. hippos* is a common species of the continental coast, replaced more or less about off-shore islands of the Atlantic by *sexfasciatus* (*C. s. latus*). In Oceania on the other hand, so far as our scanty data goes, *ignobilis* is a common and *sexfasciatus* an uncommon fish, though in the Hawaiian Islands *melampygus* related to *sexfasciatus* and less like *ignobilis* than is that species, is much more plentiful than either.

Of 11 specimens of *ignobilis* at hand, ranging from 57 to 220 mm. in standard length, 9 are from the Hawaiian Islands,[2] 2 from islands of the southeast (Hiva Oa and Mangareva).[3] These latter show slight differences, and further study may well enable us to separate the species into recognizable races over its wide range. They have a blunter, broader head, slightly smaller eye, and more tendency to canine development in upper than in lower jaw. Their eye in the head measures 4.2 versus 3.6 to 4.1 in Hawaiian specimens of comparable size, interorbital 3.7 (at 210 mm.) versus 4 to 4.1.

Measurements of the 11 specimens examined are as follows, by size groups. One specimen of 57 mm., depth in standard length, 2.6; head, 3.3; eye in head, 3.0; pectoral, 1.4; curve of lateral line in straight part, 1.25. Specimens of 85 to 100 mm. (4 specimens, depth in standard length, 2.35 to 2.5 (average, 2.41); head, 3.1 to 3.35 (3.24); eye in head, 3.5 to 3.8 (3.6); pectoral, 0.95 to 1.0 (0.97); curve of lateral line in straight part, 1.2 to 1.3 (1.25). Specimens of 133 to 142 mm. (3), depth, 2.3 to 2.5 (2.4); head, 3.2 to 3.4 (3.27); eye, 3.6 to 4.2 (3.97); pectoral 0.9; curve of lateral line in straight part, 1.2. Specimens of 185 to 220 mm. (3), depth, 2.4 to 2.6 (2.5); head, 3.3 to 3.4 (3.37); eye, 3.9 to 4.2 (4.07); pectoral, 0.8; curve of lateral line in straight part, 1.1 to 1.3 (1.2). Their soft dorsal rays number 20 to 22 (average, 20.4); anal, 16 to 18 (16.9); scutes, 26 to 33 (30.6); gill-rakers on lower limb of first arch, 14 to 17 (15.4). The smallest (57 mm.) specimen has the upper part of side bluish with 4 broad blotchy black bands more or less wider than the interspaces; a less well defined narrower band from nape obliquely downward through eye; margin of opercle slightly dusky; lower sides silver; spinous dorsal black; other fins pale. In the others, irrespective of size,

[1] Fishes Indo-Austral. Archip., 6: 254–257.
[2] Collected by Dr. B. W. Evermann, Dr. D. S. Jordan, and Mr. W. J. Morden.
[3] Collected by Mr. Templeton Crocker.

there is frequently a slight diffuse dusky blotch on the margin of the opercle, the spinous dorsal is frequently grayish and the soft dorsal has a slight dusky margin along its entire length. In 1 specimen the front of the anal also is so margined, and in another there are traces of dark cross-bands, broader than the interspaces, on the upper part of the sides.

Compared with *Caranx hippos* this species has a deeper body, the scutes better developed at the front end of the straight part of the lateral line, and lacks the characteristic blotch on the base of the pectoral fin. As in *C. s. latus* its depth decreases very slowly with increased size at this stage; its eye seems to decrease less rapidly than in *hippos* and more rapidly than in *latus*.—J. T. NICHOLS, *American Museum of Natural History, New York City.*

LENGTH-WEIGHT RELATIONSHIPS OF BULLHEADS.—Anglers in Ohio and adjacent states commonly catch black bullheads, *Ameiurus melas,* yellow bullheads, *Ameiurus natalis,* and brown bullheads, *Ameiurus nebulosus.* The length-weight relationships of these species are different, as shown by the accompanying table of measurements of bullheads from the ponds of the Ohio State Fish Farms. Mr. M. B. Trautman participated in taking some of the data and his assistance is gratefully acknowledged.

LENGTH-WEIGHT DATA ON BULLHEADS IN OHIO STATE FISH PONDS

Total Length in mm.	*Ameiurus nebulosus*		*Ameiurus natalis*		*Ameiurus melas*	
	Specimens	Weight in oz.	Specimens	Weight in oz.	Specimens	Weight in oz.
22–31	14	.010	..	....	91	.008
32–41	48	.028	26	.032	35	.039
42–51	98	.058	22	.060	58	.060
52–61	141	.092	3	.117	37	.112
62–71	51	.141	8	.181	9	.177
72–81	13	.206	13	.261	3	.266
82–91	6	.341	58	.343	3	.375
92–101	1	.625	38	.453	..	....
102–111	..	....	16	.619	..	....
112–121	..	....	2	.838	..	....
122–131	2	1.75	..	....	1	1.5
132–141	..	....	..	....	..	....
142–151	1	2.00	..	....	1	1.75
152–161	1	2.00	..	....	1	2.00
162–171	..	....	..	....	1	2.50
172–181	2	2.37	..	....	4	2.94
182–191	1	3.00	..	....	2	2.87
192–201	5	3.40	3	3.58	1	3.75
202–211	1	3.75	4	4.00	3	4.62
212–221	7	4.09	1	4.50	9	5.42
222–231	9	5.61	1	5.75	6	6.09
232–241	10	5.95	4	5.81	16	8.02
242–251	15	7.12	5	8.15	29	9.03
252–261	41	8.34	5	8.45	38	9.64
262–271	63	9.35	2	10.50	37	11.20
272–281	110	10.78	4	12.25	41	12.59
282–291	90	11.88	5	12.20	38	13.91
292–301	93	12.93	5	14.15	26	16.11
302–311	48	13.97	9	16.55	12	17.58
312–321	39	15.53	8	17.87	5	21.00
322–331	52	17.54	4	18.31	..	....
332–341	34	19.75	6	22.25	..	....
342–351	27	22.60	2	25.75	..	....
352–361	34	24.06	3	28.83	..	....
362–371	21	26.52	..	....	..	....
372–381	20	27.06	2	31.75	..	....
382–391	9	28.39	1	28.00	..	....
392–401	5	30.45	..	....	..	....
402–411	3	31.50	..	....	..	....
412–421	..	....	..	....	..	....
422–431	1	38.75	..	....	..	....

The comparative data show that the black bullheads are heavier at all length stages than the other species, that the brown bullheads are lighter than the others, and that the yellow bullheads are intermediate in this character. Also, the black bullheads are shortest when full grown, the brown bullheads longest, and the yellow bullheads again intermediate.—T. H. LANGLOIS, *Ohio Division of Conservation, Columbus, Ohio.*

POMOXIS ANNULARIS IN ONTARIO.—During the past summer, I took a number of specimens of *Pomoxis annularis* in Lake Erie at Port Crewe near Merlin, Ontario. This is of interest, in view of the few records that have been made of this species in Canadian waters. Dymond, Hart and Pritchard[1] record young, 1¼ inches long, from Burlington Bay, Lake Ontario, and Cain[2] took it in the Grand river at Dunnville. There is also a specimen in the Royal Ontario Museum of Zoology from Jordan Harbour, Lake Ontario. Of the 8 specimens of *Pomoxis* preserved from the past summer's catch at Port Crewe, 4 are *annularis* and these are larger than the specimens of *sparoides,* ranging from 13.2 to 20.5 cm. in standard length as compared to 9.0 to 12.5 cm. for *sparoides.* Both species are rare at Port Crewe, scarcely a score of specimens of both species having been taken in pound nets which take several tons of commercial fish annually.—W. A. KENNEDY, *Merlin, Ontario.*

A COMPARATIVE STUDY OF THE EFFECTS OF CERTAIN HYPNOTICS ON *LEPISOSTEUS OSSEUS* AND *ICTALURUS PUNCTATUS* AT DIFFERENT TEMPERATURES.[3]—Oxygen consumption tests indicate that fish use little oxygen when in a subdued or quiescent state. Placing a certain quantity of hypnotics in fish tanks or minnow buckets might, therefore, allow fish to remain alive for long periods without changing water or renewing the oxygen supply. Determining the concentration of an inexpensive common hypnotic securable at any drug store that would have the desired effect would be a contribution of practical value in fisheries work. With this idea in mind, preliminary experiments were conducted in the hope of finding an hypnotic that would anesthetize the fish while being transported for stocking purposes or while

TABLE 1. RESULTS OF EXPERIMENTS WITH THE EFFECTS OF NARCOTICS ON FISHES

Drug	° C.	*Lepisosteus osseus*		*Ictalurus punctatus*	
		Reactions at 1; 3; 10 min.	Recovery time	Reactions at 1; 3; 10 min.	Recovery time
Chlorotone, 0.4% solution	17°	Dead in 45 seconds	....	Dead in 30 seconds	....
	26°	Dead in 38 seconds	....	Dead in 13 seconds	....
	31°	Dead in 14 seconds	....	Dead in 7 seconds	....
Hydrated Chloral, 0.4% solution	17°	Active; active; active	....	Active; active; slow	30 sec.
	22°	Active; active; slow	2 min.	Active; active; sluggish	7 min.
	28°	Active; active; distressed	30 min.	Active; active; sluggish (died 45 min. later)	....
	31°	Active; active; out at 9 min. (died 12 min. later)	....	Active; out at 2 min. (died 15 min. later)	....
Paraldehyde, 0.4% solution	17°	Active; slow; out at 6 min.	10 min.	Active; slow; out at 4 min.	12 min.
	22°	Active; slow; out at 5 min.	12 min.	Active; out at 2.5 min.	1 min.
	26°	Active; slow; out at 4 min.	14 min.	Active; out at 2 min.	2 min.
	31°	Active; out at 2 min.	20 min.	Slow; out at 2 min.	15 min.
Ethyl urethane, 0.4% solution	17°	Active; active; sluggish	1 min.	Slow; sluggish; out at 9 min.	10 min.
	22°	Active; active; sluggish	2 min.	Active; out at 3 min.	1 min.
	26°	Active; active; out at 7 min.	3 min.	Active; slow; out at 7 min.	1 min.
	31°	Active; out at 3 min.	1 min.	Slow; out at 2.5 min.	2 min.
Sulphonal, 0.4% solution	17°	Active; slow; sluggish	1 min.	Active; slow; sluggish	10 min.
Barbital, 0.4% solution	17°	Active; active; active	....	Active; active; active	....
	22°	Active; active; active	....	Active; active; active	....
	26°	Active; active; active	....	Active; active; active	....
	31°	Active; active; active	....	Active; active; slow	1 min.
Potassium Bromide, 0.4% solution	17°	Active; active; active	....	Active; active; active	....
	22°	Active; active; active	....	Active; active; active	....
	26°	Active; active; active	....	Active; active; active	....
	31°	Active; active; active	....	Active; active; active	....
Phenobarbital, 0.1% solution	17°	Active; active; active	....	Active; active; active	....
Carbromal, 0.03% solution	17°	Active; slow; out at 5 min.	3 min.	Slow; sluggish; out at 5 min.	10 min.
	31°	Active; out at 3 min.	22 min.	Out at 1 min.	3 min.

[1] Univ. Toronto Studies (Biol. Ser.), 33, 1929: 31.
[2] Can. Field-Nat., 44, 1930: 149.
[3] Published under a grant from the American Wildlife Institute for the publication of biological researches fundamental to fish management.

contained in minnow buckets, yet would have no deletorious effect on the fish and would permit normal recovery when the fish were returned to their natural medium.

The two species of fish used in these experiments were taken directly from their native environment, well fed and free from parasites. One was a ganoid, *Lepisosteus osseus* (Long-nosed Gar) and the other a teleost, *Ictalurus punctatus* (Channel Catfish). These two fish are hardy representatives of their respective groups.

To make the experiments as comparable as possible, all specimens used were of the same weight (5 grams). Thus the relation between weight of fish and weight of solution was held constant. The temperature of water from which the fish were taken was the same as that of the test solutions in all experiments, with the exception of those run at 31° C., for which the fish were taken from water at 29° C. In this way an effect due merely to change in temperature was precluded.

1, 3, and 10 minute intervals were arbitrarily selected as times for definite statements concerning reactions which were recorded as "active" when the fish swam normally or darted away when touched; as "slow" when they swam away but did not dart in the characteristic manner; as "sluggish" when they made only feeble lateral tail movements, and no definitely co-ordinated movements. "Out at —— minutes" indicated that the respiratory movements were extremely slight; whereupon the fish were removed immediately from the solution.

Carbromal and phenobarbital were not used in the same strength as the other hypnotics because of their lower solubility. 0.4% solutions were otherwise used in order that definite reactions could be noted in limited lengths of time.

The experiments outlined in Table 1 show that:

1. *Lepisosteus osseus* is more resistant to toxicity than *Ictalurus punctatus*.

2. The results are therefore in agreement with Winterstein's statement that higher concentrations are required to depress simpler forms.

3. Increase in temperature increases the toxic effects or decreases the animal's resistance to the toxicity of the solution.

4. Richet's idea (1893) that the lower the solubility of a narcotic the greater its narcotic strength is not confirmed by the experiments here reported upon (see Table 2).

TABLE 2. RELATION BETWEEN SOLUBILITY OF NARCOTICS AND TOXICITY TO MAN AND FISHES

Drug	Molecular Weight	Solubility	Order of Toxicity To Man	Order of Toxicity To Fish
Phenobarbital	232.17	1:1000	1	8
Carbromal	237.08	1:3000	2	9
Barbital	184.15	1:130	3	6
Sulphonal	228.28	1:200	4	5
Chlorotone	175.45	1:125	5	1
Potassium bromide	119.02	1:1.5	6	7
Hydrated chloral	165.41	1:0.25	7	2
Paraldehyde	132.13	1:8	8	3
Ethyl urethane	89.08	....	9	4

Additional Experiments

Placing an 8-gram *Ictalurus punctatus* from water at 25° C. into a 0.4% solution of paraldehyde at 30° C. caused death in 1 minute.

After being kept in a 0.04% solution of chlorotone for 2 minutes a 3-gram *Ictalurus punctatus* recovered in 10 minutes.

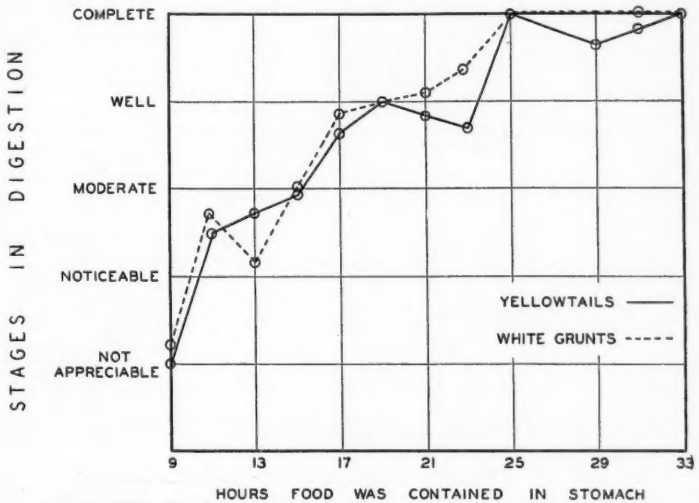
After 15 minutes in a 0.02% solution of chlorotone, another 3-gram fish of the same species recovered in 22 minutes.

Using ethyl urethane, the reactions of *Ictalurus punctatus* were not accurately correlated with increasing temperature. *Lepisosteus osseus* did not exhibit comparable resistance to this chemical.

According to Henderson (1930) little quantitative work of this sort has been done on fish. As the subject seems to be one of both scientific and economic importance, it should be investigated more thoroughly.—W. W. Aitken, *Iowa State Conservation Commission, Des Moines, Iowa.*

RATES OF DIGESTION IN THE YELLOWTAIL (*OCYURUS CHRYSURUS*) AND THE WHITE GRUNT (*HAEMULON PLUMIERI*).—The following experiment was carried out in the tanks of the Key West Aquarium. Conditions in that aquarium, where the water supply comes directly from the sea, approach the natural environment of the fishes very closely.

This experiment is a preliminary step in an endeavour to determine the food habits of the yellowtail (*Ocyurus chrysurus*) and the white grunt (*Haemulon plumieri*). The length of the period of digestion having been determined, then upon inspection of the stomach contents of a specimen the amount of food eaten and the time required to obtain the food could be estimated with a degree of certainty. Yellowtails and white grunts were selected because they represent two distinct types of very common



Digestive rate of yellowtails (*Ocyurus chrysurus*) and white grunts (*Haemulon plumieri*).

fishes, and are of considerable economic as well as biological importance. The yellowtail is a swift swimmer, feeding usually on animals capable of quick movement; the white grunt is a comparatively slow swimmer and feeds on small animals found on or very close to the bottom. Although both species feed chiefly at night, they also feed during the day, and both have widely varied natural diets.

The striped anchovy (*Anchoviella hepsetus*) was used as food in this experiment. It was selected because it is abundant, well liked by both fishes, and because it is a very uniform and easily distributed food.

The method of the experiment was as follows: a number of yellowtails and white grunts were selected. Each species was placed in a separate tank several weeks previous to the experiment, in order that the fishes might accustom themselves to their surroundings, and adapt themselves to new food habits. Both the yellowtails and white grunts were found to thrive when fed twice a week. At each feeding in the afternoon, they were given enough food to satisfy them.

At 1:00 P.M. on the afternoon set for the experiment they were fed as usual; all fishes ate well. The temperature of the water, checked constantly throughout the experiment, did not vary more than 0.5° from 24.0° C. Nine hours later the first yellowtail and the first white grunt were killed. Additional specimens of each species were killed at two hour intervals until 33 hours from the time of feeding had elapsed. The stomach of each specimen was examined when possible immediately after killing, otherwise the

stomach and intestine was removed and placed in a 10% solution of formaldehyde. Examination of these alimentary tracts was deferred until the following day.

The results of this experiment are given in the form of a graph. Five distinguishable stages in the digestion of the anchovies were arbitrarily defined. These progressive stages in digestion have been plotted against hours food was contained in the stomach.

In the first stage, described as "Not Appreciable," with the exception of some compressing of its body the anchovy shows at most the removal of the thin outer skin and the effacement of slight surface markings on that portion of its surface which was in direct contact with the stomach walls.

In the second stage, described as "Noticeable," the body markings have become partially obliterated. Portions of the head, especially around the eyes, have been removed: the bodies are much compressed and twisted.

The third stage, indicated by "Moderate," marks the point at which most of the body markings have been removed; the heads of the specimens are partially disintegrated; the flesh is very soft and portions have been removed to reveal the backbone; the caudal rays are removed; the tail is reduced to a rounded stump.

In the fourth stage, "Well," the head bones have become almost completely broken down, the bodies have been compressed almost to balls, the flesh is very soft, and pieces of the flesh have been removed from the sides. Recognition of the anchovies as such is impossible or nearly so at this stage.

The last or fifth stage marks "Complete" digestion. At this stage all food has been removed from the stomach. Material in the intestine, if any, is reduced to small grey particles.

One interesting and noticeable feature in this experiment was the resistance of the alimentary canal of the anchovies to digestive action. Despite the fact that the coelomic cavity was ruptured very early while digestion was taking place, it was not until the very late stages that any effects were apparent on the alimentary canal. The crystalline lens although difficult to locate was found practically uninjured in the small intestine in many of the experiments.

The amount of food in the stomach has a pronounced effect on the rate of digestion. Almost every instance of an irregularity in the curves on the graph, so far as could be ascertained, was due either to an overcrowded stomach or to one almost empty. Digestion progresses more slowly in a crowded than in a partially filled stomach.

The average standard length of the yellowtails and of the white grunts was 20 cm. and 19 cm. respectively. The stomachs of the yellowtails from which an accurate count could be made contained an average number of 6.5 anchovies. The stomachs of the white grunts contained an average number of 3.9 anchovies. The average length of the anchovies was about 5.5 cm. One may infer from the foregoing data that normally the capacity of the yellowtails is greater, even with respect to size, than that of the white grunts.

The digestive rate in the white grunt was steadier and faster than in the yellowtail. In the latter there were several instances in which digestion was retarded. This happened only once with the white grunt. At the end of 25 hours the stomachs of one of the white grunts was empty, and all specimens examined thereafter were empty also. Although at the 25 hour stage the stomach of one yellowtail was empty, the remaining specimens all retained a slight amount of undigested material (see graph).—E. LOWE PIERCE, JR., *Key West Aquarium, Key West, Florida.*

AN OLDER NAME FOR THE BLACK-NOSED DACE.—My attention has unfortunately been called to a rare and generally unused book by Johannes Hermann, containing the original descriptions of several fishes, one of which pertains to a common North American freshwater fish, the Black-Nosed Dace. The title page of this neglected book on vertebrates reads: Johannis Hermann. . . . Observationes zoologicae quibus novae complures, aliaque anamalium species describuntur et illustrantur Opus posthumum edidit Fridericus Ludovicus Hammer. . . . Argentorati. . . . Parisiis. . . . XII (1804). The pagination is i–viii, 1–332; the only figure is the frontispiece, a portrait of the author. "IV. Pisces" covers pp. 290–328. Several of the new fishes described are unrecognizable at the moment, but the description of *Cyprinus atratulus* was unquestionably based on the species now known as *Rhinichthys atronasus*. The full description follows:

CYPRINUS ATRATULUS. Nobis.

Argenteo et nigricante varius, pinnis dorsali, ventrali, analique radiis octo.

Dors. 8. Pect. 16. Ventr. 8. Anal. 8. Caud. 19.

Squamae minutae, ambitu punctis nigris. Ordinum octodecim a dorso ad lineam lateralem; ordinum decem ab inde ad analem. Linea lateralis flexuosa. Longitudo triuncialis. Latitudo semipollicaris. Caput ad latus nigrum praeter maculam argenteum sub oculis, et discum operculi.—Cyprinus phoxino affinis. Ex collectione Ramsayana, ergo sine dubio ex America septentrionali.

This description applies to no species other than *Rhinichthys atronasus,* among those which may reasonably be expected to have been sent to Europe from America prior to 1804. For the time, the description was rather diagnostic.

Cyprinus atratulus Hermann (1804) clearly antedates *Cyprinus atronasus* Mitchill (1815). We therefore are obliged to rename one of our commonest minnows as *Rhinichthys atratulus* (Hermann), with the following recognized subspecies:

Rhinichthys atratulus atratulus (Hermann)—Atlantic drainage.
Rhinichthys atratulus meleagris Agassiz—Great Lakes–Upper Mississippi drainage.
Rhinichthys atratulus obtusus Agassiz—Tennessee Upland.
Rhinichthys atratulus simus Garman—Gulf drainage, Alabama and Georgia (type from Coahulla Creek, Georgia. not Coahuila, Mexico).

Hermann names several other American fishes, of which *Esox nudus* (p. 313) and *Clupea alepidota* (p. 315) are at the moment unrecognized. *Silurus mollis* was obviously based on some ameiurid, but on which one is not clearly apparent. It was described as follows:

SILURUS MOLLIS. Nobis.

Pinna dorsali postica adiposa, cirris maxillae superioris quatuor, pinna anali radiis duodecim, radio primo dorsali pectoraliumque adjacenti spinae capitis similium mollibus candidis.
Venter valde mollis et flaccidus.
Ex America. Musei Humphrediani p. 131. No. 33.

The capelin, *Mallotus villosus,* is called *Clupea lodna* (from Iceland, described from plate by Olafsen and Povelsen).—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

NOTES ON THE SNAKE BLENNY *LUMPENUS LAMPETRAEFORMIS* (WALBAUM) FROM THE NORTH ATLANTIC.—It has long been known that the snake blenny undergoes certain changes in body proportions with age and that a variation exists in the number of its vertical fin rays. Collett,[1] for example, pointed out that the head is relatively smaller and the depth less in adults than in young and that the dorsal ray count ranges from 68 to 74 and the anal from 49 to 54 for various European specimens.

Vladykov[2] in a recent paper listed differences between small and medium sized fish from the Gulf of St. Lawrence and large fish from Newfoundland on the basis of which he recognized three subspecies, designating the European form as *L. lampetraeformis lampetraeformis,* the St. Lawrence form as *L. lampetraeformis americanus* and the Newfoundland form as *L. lampetraeformis terrae-novae.* This separation was based chiefly on the number of fin rays, the length of head and the depth of body. The St. Lawrence fish examined had 75 to 79 dorsal and 52 to 56 anal rays while the two Newfoundland fish examined had 85 dorsal and 62 anal rays. The length of the head of the St. Lawrence fish ranged from 12.3 to 14.7 per cent of the body length whereas in the Newfoundland specimens it was 9.5 per cent while the body depth of the former was 6.1 to 7.0 as against 4.0 to 4.6 per cent for the latter.

However, the several specimens of snake blenny collected recently by the *Albatross II* in the Gulf of Maine, between Mt. Desert and Cape Ann, proved to have fin counts intermediate between the two Canadian subspecies as distinguished by Vladykov, and the larger fish had relatively smaller heads and were more slender than the smaller fish as the following table will show:

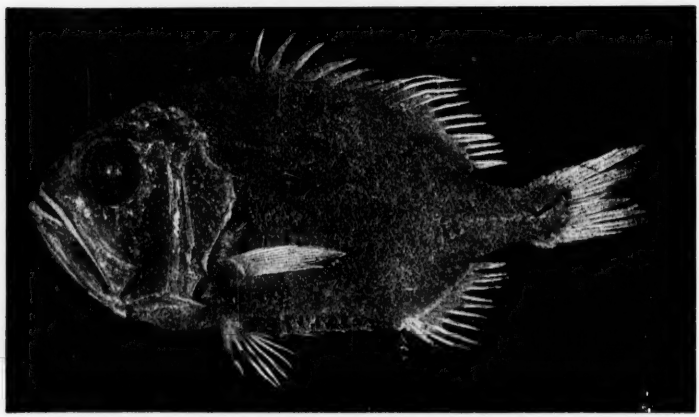
Total length, mm.	198	204	285	480[a]
Standard length	176	179	250.5	419
Proportionate measurements:				
Depth at ventrals	6.2	6.1	5.5	4.6
Head	14.5	13.7	12.2	10.7
Caudal	12.5	14.0	13.5	14.5
Snout to dorsal	13.9	14.0	11.5	10.8
Snout to anal	38.0	36.8	39.6	32.0
Dorsal rays	80	77	81	83
Anal rays	54	55	56	60

[a] This is the largest example of the species on record.

[1] Robert Collett, The Norwegian North Atlantic Expedition, 3, 1876–1878 (1880): 73.
[2] V. D. Vladykov, Appendix C, Annual Report, Fishery Research Laboratory, Dept. Natural Resources, Newfoundland, 1934 (1935).

Hence, in the northwest Atlantic, at least, there is adequate evidence for the recognition of only one form of this subarctic species and, according to present evidence, the European and American forms are likewise essentially the same. A further study of the variation in this species, based on a large number of specimens, is called for.—WILLIAM C. SCHROEDER, *Museum of Comparative Zoology, Cambridge, Massachusetts.*

GEPHYROBERYX DARWINII (JOHNSON), A BERYCOID FISH NEW TO THE NORTH AMERICAN FAUNA.—In February of 1933, while stationed at Norfolk, Virginia, I was most fortunate in securing many interesting specimens of comparatively rare fishes through the cooperation of the fishermen operating the winter trawling fleet. Captain Favaloro of the vessel *Grace F.* in particular aided me in building up a unique collection. Among other species I came upon a small deep-sea form, which according to Goode and Bean's *Oceanic Ichthyology* seemed to be a *Trachichthys.*



Specimen of *Gephyroberyx darwinii* 89 mm. in standard length, taken off Virginia.

Inability to find any traces of previous American records of this species caused me to proceed cautiously in the matter of recording its discovery. After a careful study of the literature and with the kind assistance of Dr. G. S. Myers of the U. S. National Museum it was found that the specimen was a *Gephyroberyx darwinii* (Johnson).[1] The fish has been presented to the U. S. National Museum, where it is catalogued as number 93623.

The color of this fish was a pale beet red on the upper parts of the body, fading to a lighter grayish shade ventrally. The fins were red, tipped with black. It was trawled in from 40 to 50 fathoms of water on the continental slope E. × S. of Chesapeake Light Ship, Virginia.

The identification of this specimen, which measures 89 mm. in standard length, seems satisfactory. Furthermore 2 additional larger specimens (now in the American Museum of Natural History) have since been obtained from the same area in 50 to 60 fathoms, in February and March, 1936. They measure respectively 250 and 300 mm. in standard length, and were of a somewhat deeper red than the smaller fish, and quite uniform in color. However, since there are no Madeiran specimens in America for comparison, one may consider the identification tentative until material from these two remote places has been compared.—F. E. FIRTH, *U. S. Bureau of Fisheries, Biological Laboratories, Harvard University, Cambridge, Massachusetts.*

[1] *Trachichthys darwinii* Johnson, Proc. Zool. Soc. London, 1866: 311, pl. 32 (Madeira).

Reviews and Comments

A KEY TO THE LIZARDS OF THE UNITED STATES AND CANADA. By Charles E. Burt. *Trans. Kansas Acad. Sci.*, 38: 255–305, 71 figs.—The unsatisfactory nature of the available general accounts of North American cold-blooded vertebrates has been a matter of concern to herpetologists during the recent years of active work in this field. Important technical papers, revisions of genera, and scores of minor studies have appeared, stimulated by and reacting in their turn upon the successive editions of the invaluable "Check List." Blanchard's "Key to the Snakes" and the Wright's "Handbook of Frogs and Toads" are the first comprehensive means of identification pitched to the newer levels of our knowledge. Other works, on other groups of amphibians and reptiles, are in progress. Dr. Burt's new "Key to the Lizards" thus fills a gap in the series of general accounts, and will certainly prove valuable as a means of acquainting students with the North American lizard fauna and of equipping them for its study. The figures illustrating the key characters are especially well chosen. The work in general has been carefully done and exhibits a great deal of thoughtful and painstaking work.

The list of species recognized reflects a tendency notable in Dr. Burt's work toward a reduction, rather than a multiplication, of their number, and toward a reduction of forms recognized by others as species to the status of subspecies. There can be no difference of opinion regarding the desirability of reducing the number of recognized forms when such reduction reflects the facts in nature. The classic difference, however, between "splitter" and "lumper" may rest on a different interpretation of identical data. Thus Burt published a paper (1928) to demonstrate that the western and eastern subspecies of *Crotaphytus collaris* should be united, in which the data presented are interpreted by the present writer as an interesting example of a pair of recognizable subspecies with an unusually broad area of intergradation. A very different type of divergence of opinion between Dr. Burt and the reviewer is illustrated by the distinction of *Crotaphytus silus* and the remark upon it in the present key. This species is distinguished from *C. wislizenii* by a rather indefinite statement as to the length of the snout, with a footnote to the effect that it is "but poorly differentiated." This treatment ignores the notable differences in color pattern and scutellation between these species; and it illustrates the principal weakness of keys in general, namely, an artificial choice of "key characters" which acquire a fictitious importance in the minds of beginners, and sometimes in those of the key makers themselves. Dr. G. A. Boulenger, quite obviously on account of an unfortunate choice of key characters, contributed no less than twelve names to the synonymy of the coral snakes, while referring an even larger number of valid forms to synonymy.

Turning to the question of form, it is useful to have a renewed illustration of the "spread dichotomous key" as contrasted with the numbered heads of the "closed" type. The writer's preference for the latter is confirmed, especially for an artificial key, and especially if the figures are distributed through it at the appropriate points. A natural key is frequently best in the spread type. Double-keying may occasionally be necessary, but "multiple keying" can be avoided in many cases by giving the necessary combinations of characters in one place. It is disconcerting to find *Eumeces fasciatus* appearing no less than five times. A few of the definitions of terms in the glossary are subject to criticism, or are vague, and the general statements of the preface and footnotes do not always seem to express what I believe to be the meaning intended.

It is to be hoped that Dr. Burt's key will have a wide circulation and its existence cannot fail to promote active work among students of North American herpetology. It prepares the way for and brings us much closer to a competent Handbook of North American Lizards.—Karl P. Schmidt, *Field Museum of Natural History, Chicago, Illinois.*

NATURGESCHICHTE UND WIRTSCHAFTLICHE BEDEUTUNG DER SEEFISCHE NORDEUROPAS. By Ernst Ehrenbaum. Handbuch der Seefischerei Nordeuropas (edited by Drs. H. Lübbert and E. Ehrenbaum, published by E. Schweizerbartsche Verlagsbuchhandlung, Stuttgart), 2, 1936: 337 pp., 276 figs. Price, unbound, 33 R.M., outside of Germany.—In this treatise on the marine fishes of northern Europe a vast amount of data, scattered throughout a considerable literature, has been brought together in one comprehensive account. In addition, Dr. Ehrenbaum has added much from his own extensive knowledge of European fishes. The book is designed especially for the wishes and needs of the biologist and of those interested in the fisheries. Systematic descriptions and details of distribution and occurrence are reduced to a minimum, but life histories and all the commercial aspects of the species are described extensively, the most lengthy accounts naturally being given to those fishes of greatest importance. The Ganoidei, Teleostei, Elasmobranchii, Cyclostomi and Leptocardii is the order of arrangement followed. No attempt was made to list all the species known from north European Seas but nevertheless isolated occurrences are included when they deal with fishes that are commercially important in other areas or are biologically noteworthy.

Thus the chapter on the cod includes a brief description of the species and its distribution, the development of the eggs and young, migrations, food, the commercial fisheries and a bibliography listing the more important references. Data on the cod from Newfoundland and the northwestern Atlantic are also given. On the other hand, in the groups of little commercial importance, such as the Macruridae of which six species are listed, about one-half page is devoted to the most common and only one or several lines to the rarer ones. The book is well illustrated, includes numerous tables and statistics of catch covering a period up to 1932, has a bibliography covering the more important titles and an adequate index. Common names by which the fish are known in various languages is another feature. American ichthyologists as well as their European confreres should find this a very useful book.—Wm. C. Schroeder, *Oceanographic Institution, Woods Hole, Massachusetts.*

GAME FISH OF THE SOUTH AND HOW TO CATCH THEM. By L. S. Caine. The Riverside Press, Cambridge, Mass., 1935: i–ix, 1–259, num. figs. $2.75.—Part one describes the common game fishes of the southeastern United States. For each species the author gives the scientific name, a list of common names, coloration, average size, world's record size, food value, natural foods, artificial lures, methods of fishing and waters frequented. Part two is devoted to the equipment needed for each type of fishing and its proper care. Part three is a brief description of the methods of fishing. The remaining parts treat of natural baits and their use, shrinkage in weight of fish after death, a formula for determining the weight of a fish from length and girth, a fishing directory, etc. In stating the method for determining the age of fish by the scales the ridges and the annuli are confused: The Sting Ray is called a mammal. Salt water fish and fishing receive most attention. This book should be particularly useful to the angler about to make his first trip to southern waters.—A. S. Hazzard, *Institute for Fisheries Research, University of Michigan, Ann Arbor, Michigan.*

FISHES OF THE CRANE PACIFIC EXPEDITION. By Albert W. Herre. *Field Mus Nat. Hist.*, (Zool.) 21 (Publ. 353), 1936: 1–472, figs. 1–50. $3.50.—Dr. Herre's long-awaited report on the fishes of the Crane expedition has now appeared. In it are figured most of the 50 new forms described in a preliminary paper.[1] With the exception of one new flying fish from the West Indies (since synonymized by Bruun) and a few fresh-water species from Panama, all of the collections reported on are from the Pacific, beginning with the Galapagos and Cocos islands and ending with the fresh-water fishes obtained in the Sepik River, New Guinea. The largest lists are from Fiji, the Solomons, and the New Hebrides, island groups whose fishes are little known. The most interesting of the new forms is *Disparichthys fluviatilis* from the Sepik, said to represent a new family of eels. The reviewer examined the unique type at the time of its description and feels quite certain that it is not an apodal fish; possibly its relations should be sought

[1] Field Museum (Zool.), 18, 1935: 383–438, figs. 31–33.

among the blennies. Of the other fishes, I wish to note that *Alepideleotris tigris* Herre, from the Galapagos, is doubtless the same as *Eleotrica cableae* Ginsburg,[2] and that *Boroda malua* Herre, from the Sepik, is probably *Eleotris herwerdenii* Weber.[3] The only general criticism I wish to offer is a protest against publishing descriptions of new species, however carefully done, without discussion of probable relationships.—GEORGE S. MYERS, *United States National Museum, Washington, D. C.*

RECENT HANDBOOKS ON OLD WORLD FISHES.—Three regional books, one technical and two popular, have recently appeared:

THE FISHES OF THE INDO-AUSTRALIAN ARCHIPELAGO VII PERCIFORMES (CONTINUED) FAMILIES: CHAETODONTIDAE, TOXOTIDAE, MONODACTYLIDAE, PEMPHERIDAE, KYPHOSIDAE, LUTJANIDAE, LOBOTIDAE, SPARIDAE, NANDIDAE, SCIAENIDAE, MALACANTHIDAE, CEPOLIDAE. By Max Weber and L. F. de Beaufort. E. J. Brill, Leiden, 1936: i–xvi, 1–607, figs. 1–106.—To ichthyologists, the most welcome of the recently published fish books is this 7th volume of the valued treatise on East Indian fishes, being prepared by our distinguished Dutch colleagues, Weber and de Beaufort. These authors have critically treated the genera and species, making use of recent contributions by other authors to the knowledge of the families included. About 100 of the species are illustrated by real figures that provide a relief from the often characterless outline sketches now becoming a fad in regional fish manuals. The keys, synonymies, descriptions and distributional statements are complete enough to be really serviceable. No one should attempt work on the vast Indo-Pacific fish fauna without this monograph.

EDIBLE FISHES OF MANILA. By Agustin F. Umali. *Phil. Dept. Agri. and Comm., Pop. Bull.* 6, 1936: 1–192, figs. 1–145, pls. 1–8.—This well-prepared booklet first treats fish as food for man in the Tropics, the source of fish for Manila, the local markets and sanitary supervisions; then gives a glossary of technical terms, a systematic list of the edible fishes of Manila, and a key to the families. Under each family an introduction deals with characteristics, ecology, and number of Philippine species, and with "Supply and marketing conditions" and "Eating qualities." Keys to species are introduced for the larger families. The account of each species is headed by the scientific name and a bookish English name, followed by brief items on "Vernacular name," "Distinctive features," "Colors," and "Size." Most of the species treated are illustrated by line drawings, which are less deficient in character than the outline sketches that imperfectly illustrate most recent regional fish handbooks. Often only the commonest species of a family is included. As a whole the work seems relatively free of errors. Some inaccuracies, for instance, the use of the name *E. hawaiensis* rather than *E. machnata* for the East Indian *Elops*, merely reflect the errors of other workers.

THE SOUTH AFRICAN MARINE FISHES OF COMMERCIAL AND ANGLING IMPORTANCE. By J. M. Marchand. Union of South Africa, Department of Commerce and Industries, Fisheries and Marine Biological Survey Division, Fish. Bull., No. 2, 1935: 1–160, figs. 1–115. 5s.—This handbook follows with considerable fidelity Walford's *Handbook of Common, Commercial and Game Fishes of Southern California.* The account of each species, as in that work, is headed by a photograph, and by enough text to fill the page, with the following headings: Taxonomy, Characteristics, Distribution, Fishing Season, Importance and Fishing Gear. The introduction contains a list of the works used in the compilation. There follows a list of common and scientific names, topographical figures, and a glossary of anatomical and descriptive terms. The appendix explains the types of fishing gear used in South Africa and the meaning and use of scientific nomenclature.—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

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[1] See Myers, Trans. San Diego Soc. Nat. Hist., 7 (11), 1932: 113, pl. 7.
[2] Proc. U. S. Nat. Mus., 82 (20), 1933: 11, fig. 1 (Chatham Island, Galapagos).
[3] Nova Guinea, 9, Zool., livr. 4: 594, pl. 13, fig. 2, and pl. 14, fig. 2 (Lorentz R., New Guinea).

EDITORIAL NOTES AND NEWS

1936 Meeting

THE 1936 meeting of the American Society of Ichthyologists and Herpetologists will be held at Ann Arbor, Michigan, from Monday, August 31, to Wednesday, September 2. Probably all members and guests can be accommodated at the Michigan Union (for men or families) or at the Women's League (for women or families), at the University: reservations may be made directly, or through Mrs. Helen T. Gaige (University Museum, Ann Arbor). As it will be convenient to travel on the preceding week-end, the sessions will start at 9:00 A.M., Monday morning, at the Museum of Zoology of the University of Michigan. After luncheon, the technical sessions will continue through the afternoon. The annual dinner will be held at the Michigan Union Monday evening, followed by an exhibit to illustrate the early development of American ichthyology and herpetology. This exhibit, and the commemorative cooklet to accompany it, are being contributed by the Clements Library of Early Americana; the exhibit will include some of the rarest treatises on American fishes, amphibians and reptiles, and should prove an outstanding feature of a large and interesting meeting.

Sessions for papers will continue Tuesday morning and afternoon, September 1, on which day the University will provide a complimentary luncheon. Arrangements will be made for Wednesday, to accommodate herpetologists who wish to consult the collections or library of the Museum, to make local trips or to hold discussions.

The ichthyologists who wish to attend the tour of the American Fisheries Society on September 2 may go to Grand Rapids Tuesday evening by train (leaving at 6:20 P.M., Eastern Time; arriving at 9:15 P.M.) or by car (a drive of about 3 hours). The tour, for which transportation will be provided, will include a stop at the Kellogg Bird Sanctuary and an inspection of the Wolf Lake Fish Hatchery, one of the largest hatcheries and rearing stations for both trout and warm-water species. Those who drive from Ann Arbor Wednesday morning (some space will be available) will contact the Fisheries Party at Wolf Lake, where the State Department of Conservation is providing a complimentary luncheon. The sessions for papers in the fisheries fields will be held at the Hotel Pantlind, the headquarters of the Fisheries Society at Grand Rapids, on September 3 and 4, leaving the following week-end for the journey home. Whereas this is not a joint meeting, the members of the two societies are invited to attend both gatherings. Ichthyologists who have not attended recent meetings of that Society will find the sessions of the American Fisheries Society of real interest and value. Similarly, the fisheries technicians who have not attended the American Society of Ichthyologists and Herpetologists should find it worthwhile to attend our sessions.

Titles, accompanied by an indication of time required, in general not to exceed 15 minutes, and of projecting equipment needed, are requested at the early convenience of the contributors. This information should be sent to Mrs. Helen T. Gaige, Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

Meeting of the Western Division

THE Secretary of the WESTERN DIVISION of the American Society of Ichthyologists and Herpetologists reports as follows on the meetings of the Division held on June 17, as usual as an affiliate of the Pacific Division of the American Association for the Advancement of Science:

The eighth annual meeting of the Western Division of the Society was held in Room 6, Johnson Hall, University of Washington, Seattle, Washington. This was one of the most successful meetings of the Western Division; about 80 members and guests were present. One of the outstanding features of the program was the presentation of papers dealing with the fisheries problems of the Pacific Northwest; the entire afternoon

session was given over to this subject. An interesting exhibition of live material consisting of rattlesnakes, gartersnakes and horned toads was given by Dr. Philip Pope of Whitman College, Walla Walla, Washington. An exhibition of preserved material by Philips G. Putnam of Anacortes, Washington, also attracted much attention.

1. **Notes on the Longevity of some Captive Amphibia, A Review.**—Philip Pope.
2. **Man and Reptiles in Tropical Mexico.**—W. Mosauer.
3. **The Homing Habits of Some Pomacentridae.**—A. W. Herre.
4. **The Food Habits of Crater Lake Trout.**—J. Stanley Brode.
5. **The Sympathetic Nervous System of Chimaera colliei.**—M. Maxwell and L. E. Griffin.
6. **The Structure of the Internal Ear of the Lamprey, Entosphenus tridentatus.**—Dorothy Tonkin and L. E. Griffin.
7. **Flying Fishes: Their Derivation and Relationships.**—Theo. H. Eaton, Jr.
8. **Life History of Rana rugosa.**—Arthur Svihla. (By title.)
9. **A Quantitative Study of the Insensible Perspiration of the Turtle (Chrysemys marginata Agassiz).**—Frances Baldwin, Ralph Shaw and Wilbur Knupp. (By title.)
10. **The Fishes of Okanogan Lake, B. C.**—W. A. Clemens.
11. **Fish Diseases: A Problem in Our Hatcheries.**—John Guberlet.
12. **Foundations for a Statistical Study of the California Marine Sport Fishery.**—Richard S. Crocker. (By title.)
13. **Variations in the Number of Vertebrae in the Sardine (Sardinops caerulea Girard).**—Frances N. Clark. (By title.)
14. **Seasonal Occurrence of the Five Species of Pacific Salmon in the Puget Sound and the Gulf of Georgia.**—G. B. Kelez.
15. **History of the Frazer River Sockeye Salmon Fishery.**—George A. Rounsefell.
16. **Progress Report on the Investigation of the Postlarval Stages of Certain Cods of the Northeastern Pacific Ocean.**—Alan De Lacy.
17. **Salmon Migrations in the Upper Columbia River.**—J. A. Craig and A. J. Suomela.
18. **Experiments with a Revolving Fish Screen.**—Wilbert M. Chapman.
19. **An Analysis of Competition between Gear in a Trap Fishery.**—Fred A. Davidson.
20. **Osteology of the High Brow, Zaprora silenus, with notes on Distribution and Young Stages.**—W. M. Chapman. (By title.)
21. **Experiments on the Effect of Temperature on the Growth of Scales of Chinook Salmon.**—Leonard P. Schultz and Robert Meigs.
22. **The Collection of Daily Statistics on the Commercial Fishery in the State of Washington.**—Lloyd A. Royal.
23. **The Puget Sound Bottom Fishery.**—R. T. Smith.
24. **Oceanic Fishes from the Northeastern Pacific Ocean Collected by the International Fisheries Commission.**—W. M. Chapman.
25. **The Occurrence of the Whitefish in the Yakima River.**—A. J. Suomela. (By title.)
26. **Is Inopsetta ischyra, a Rare Flounder in Puget Sound, a Hybrid?**—Leonard P. Schultz and R. T. Smith.

The following were elected as officers for the coming year: President, ROLF L. BOLIN, Hopkins Marine Station, Pacific Grove, California; Vice President, Major CHAPMAN GRANT, San Diego, California; Secretary-Treasurer, ARTHUR SVIHLA, State College of Washington, Pullman, Washington.

Fish and Fishery Investigators

DR. ALBERT W. HERRE, Curator of the Zoological Museum, Stanford University, will sail on August 27 for another extended collecting trip. His first stop will be the fisheries experiment station at Tinghai, Chusan Islands, China, where he will work on marine fishes. Some collecting will be done at Hong Kong and Canton, then a couple of months will be spent in the Philippines, mainly in the Sulu Sea. A river trip into the interior of British North Borneo is planned, after which two months will be spent in the Malay Peninsula. An attempt will be made to collect in regions where no fresh-water fishes have ever been obtained.

DR. GEORGE S. MYERS has resigned his position as Assistant Curator in charge of the Division of Fishes of the U. S. National Museum, to accept a position of Associate Professor of Biology and Curator of the Zoological Collections at Stanford University. It is gratifying to learn that Stanford is definitely remaining a leading center of ichthyological research, carrying on the Jordan tradition. At the time of writing, the National Museum has not announced a successor.

DR. NICOLAS BORODIN has retired as Curator of Fishes in the Museum of Comparative Zoology, moving to California. No successor has been announced.

JACOB ELLSWORTH REIGHARD, Professor Emeritus of Zoology at the University of Michigan, widely known for his researches in the natural history of fishes, was granted the honorary degree of Doctor of Science by his University, in June.

H. WESLEY CURRAN, who recently returned from Brazil, has been appointed to a position in the Department of Biology of Queen's University, Kinston, Ontario. GERALD P. COOPER is resigning his fellowship in the Institute for Fisheries Research to become

Instructor in Zoology at the University of Maine, where he will teach ichthyology and fisheries research, and will carry on investigations in fish management for the state. EARL E. HOOVER has recently assumed the duties of Biologist of the New Hampshire Fish and Game Department. VERNON BROCK has become Biologist of the Oregon Fish Commission, and is devoting his energies in large part to a study of the sardine or pilchard of that state. Dr. VADIM D. VLADYKOV, formerly with the Biological Board of Canada, is now engaged as Fishery Biologist for the Maryland Conservation Department, studying the striped bass in Chesapeake Bay. It is gratifying to note how rapidly positions in the field of fishery biology are opening up.

HENRY O'MALLEY, one of the prominent figures in the field of fisheries work in America, died at Seattle, Washington, on April 24, at the age of 60 years. Mr. O'Malley was a career man in the Bureau of Fisheries, for he began his service in fish hatcheries at the age of 21. After considerable work in hatcheries in various parts of the country, gradually rising in rank, he was appointed U. S. Commissioner of Fisheries on May 13, 1922, in which position he was continued for 11 years until removed for political reasons. Although a practical fish culturist, Mr. O'Malley, largely through his intimate contacts with the late Dr. C. H. Gilbert, had a fine appreciation of the value of scientific work in the fisheries, and was very effective in expanding the activities of the Bureau of Fisheries along investigative lines.

The California trout investigations, cooperatively sponsored by the U. S. Bureau of Fisheries and the California Division of Fish and Game, has moved into new quarters in the Natural History Museum at Stanford University. The personnel of this investigation consists of Dr. Paul R. Needham and Allan C. Taft, of the Bureau, and Leo Shapavalov and Leo Erkkila, of the California Division.

The California Division of Fish and Game has decided to continue its well-known quarterly journal, *California Fish and Game,* as a technical journal, leaving popular presentations to the newly established *California Conservationist.*

Herpetological News Notes

THE editors, MAJOR CHAPMAN GRANT and WALTER L. NECKER, are to be congratulated on the initial appearance of the new periodical *Herpetologica* (July 11). The pleasing format and typography as well as the choice of articles shows careful discrimination by the editors and promises well for future issues.

MR. PERCY VIOSCA, JR., 517 Decatur St., New Orleans, Louisiana, is making a study of the forms of *Necturus* found in the Gulf coastal streams. Specimens from the territory north of the immediate Gulf coastal region are rare in collections. As this material would be very useful in comparisons, Mr. Viosca requests us to announce that he would like to see specimens with locality data from the Missouri and Ohio rivers and southward, on a loan or exchange basis. He has ample material from the Great Lakes region. A key is being prepared which should be helpful to all who are interested in this genus.

Mexican collectors this summer include DR. NORMAN HARTWEG and JAMES OLIVER, of the Museum of Zoology, University of Michigan, and DRS. EDWARD TAYLOR and HOBART SMITH, of Kansas University. DR. SMITH has been awarded a National Research Fellowship for the coming year, which he will spend in further studies on the Mexican lizards at the Museum of Zoology, University of Michigan.

Support of Copeia

CONTRIBUTIONS to the expense of publishing the last number of COPEIA were generously made by WILLIAM K. GREGORY, ALBERT COLLIER, CHAPMAN GRANT and PERCY VIOSCA, JR. In the present number, the cost of publishing one paper and one note is being defrayed from a grant made by the AMERICAN WILDLIFE INSTITUTE, for the publication of contributions fundamental to fish management. It is expected that financial assistance for the publication of such papers will be available for future numbers of our journal.